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PROBLEMS CONFRONTING SMALL MANUFACTURERS IN AUTOMATING THEIR FACILITIES

HEARING

BEFORE THE

SUBCOMMITTEE ON
INNOVATION, TECHNOLOGY AND PRODUCTIVITY

OF THE

COMMITTEE ON SMALL BUSINESS
UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

FIRST SESSION

ON

PROBLEMS CONFRONTING SMALL MANUFACTURERS IN AUTOMATING THEIR FACILITIES

PART 1

DECEMBER 2, 1987

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CONTENTS

Statement of Senators: Page

Levin, Hon. Carl, a U.S. Senator from the State of Michigan 1

Rudman, Hon. Warren, a U.S. Senator from the State of New Hampshire 3

Kerry, Hon. John F., a U.S. Senator from the State of Massachusetts 114

Bumpers, Hon. Dale, a U.S. Senator from the State of Arkansas 123

Statement of:

Buerk, Richard K., vice president, Buerk Tool & Machine Corp., Buffalo, NY, accompanied by Bruce Hahn, National Tooling & Machining Association 143

Conran, Mary, president and CEO, Warren Industries, Inc., Philadelphia, PA 172

Jaikumar, Ramchandran, professor, Harvard Business School, Boston, MA 20

Kegg, Dr. Richard, vice president and manager, Manufacturing Systems Division, Cincinnati Milacron, Cincinnati, OH 4

Koontz, James L., president and CEO, Kingsbury Machine Tool Corp., Keene, NH, accompanied by James Mack, public affairs director, National Machine Tool Builders Association 50

Mittelstadt, Eric M., president and CEO, GMF Robotics Corp., Troy, MI 84

Stokes, Jerald D., partner, Arkansas Technologies, Inc., Clarksville, AR 126

HEARING DATE

December 2, 1987:

Morning session 1

PROBLEMS CONFRONTING SMALL MANUFACTURERS IN AUTOMATING THEIR FACILITIES

DECEMBER 2, 1987

U.S. SENATE,
SUBCOMMITTEE ON INNOVATION,
TECHNOLOGY AND PRODUCTIVITY,
COMMITTEE ON SMALL BUSINESS,
Washington, DC.

The Subcommittee met, pursuant to notice, at 9:35 a.m., in room SR428A, Russell Senate Office Building, Hon. Carl Levin [Chairman of the Subcommittee] presiding.

STATEMENT OF HON. CARL LEVIN, A U.S. SENATOR FROM THE STATE OF MICHIGAN

Senator LEVIN. The Subcommittee will come to order. After my brief opening statement, a statement from Senator Rudman, who is the ranking minority Member of the Subcommittee, will be made part of the record. He has a conflict and cannot attend the hearing this morning.

He particularly regrets not being here, not just because the subject is so important to him but also because Jim Koontz happens to come from New Hampshire, and he will be testifying here later on today. And he will miss a chance to say personally hello to Jim.

What we are witnessing is a modern American tragedy, a tragedy that will lower our standard of living, and the standard of living of our children—the erosion of our manufacturing base and our international competitiveness in the production of goods.

We need only to walk through just about any retail store to realize the severity of this problem. The domestic manufacturers who have managed to hang on and continue their business are reeling from the effects of this situation daily.

Since the early 1970s we have experienced significant increases in imports of all kinds of items, including electronic computing equipment, lighting fixtures, power-driven handtools, printing trades machinery, semiconductors, telephone and telegraph equipment, and many other products. These imported goods have displaced and are continuing to displace, domestic production.

Manufacturing has long been a key element in our economy. A recent study by the Congressional Research Service, whose author is here this morning, presents a startling example of how we have lost ground.

According to the report, in 1982, and this is just one example, the machine-tool business, essentially a small business industry, had 75 percent of the American market and foreign firms had 25 percent of the American market.

Today, just 5 years later, the market is split 50-50. The number of U.S. firms making machine tools has dropped from about 1,500 to 500. And the number of workers has declined from 100,000 to 72,000.

This reduced manufacturing base is limiting our ability to produce here, and many of our best product ideas are being made in other countries. This country is recognized for its ability to innovate, and we continue to lead the world in this capacity.

But it is pretty obvious that no matter how adept we are at coming up with ideas, it will not do us much good if we continue to have these ideas turned into production by foreign producers.

Our economy will suffer, and our national security will be threatened, as our ability to produce goods for our defense industrial base is reduced.

Today's hearing is the first in a series of hearings of this subcommittee that is going to examine one of the most critical issues affecting the competitiveness of this country. That issue is small business use of advanced technology.

It is clear that in order to maintain and expand our international competitiveness, that we will have to increase small business use of advanced technologies, technologies which will improve the ability of small manufacturers to produce goods.

In the course of this hearing, we will receive testimony from some of the best minds in the country on this subject. We will hear about the status of domestic and foreign small manufacturers, the current and future applications of advanced technology, and the experiences of small firms that have pursued advanced technology.

This testimony, and the testimony from the hearings that will follow, will help us pursue an effective policy to prevent the further decline of, and to enhance, our manufacturing capabilities.

In other words, to increase our international competitiveness. Unless we do so, our economic future and our Nation's position in the world are simply less secure.

[The prepared statement of Senator Rudman follows:]

STATEMENT
of
Senator Warren B. Rudman

Mr. Chairman, I'm very pleased the subcommittee has decided to embark on this series of hearings to review the impact of automation on small businesses in America. We have a distinguished list of witnesses here today, and I'm particularly pleased that James Koontz of the Kingsbury Machine Tool Corporation in New Hampshire has consented to testify. Mr. Koontz will be able to give us his perspective on this issue from the suppliers point-of-view.

If small business is to retain its role as the catalyst of economic growth in this country, it is essential that it become as competitive as possible with other businesses throughout the world. Automation and higher technology are undoubtedly the key to reviving our competitive spirit.

Again, Mr. Chairman, I congratulate you on initiating these hearings and I look forward to the testimony of our witnesses.

Senator LEVIN. Our first panel today is made up of Dr. Richard Kegg, who is the vice president and manager of the Manufacturing Systems Division of Cincinnati Milacron, Cincinnati, OH.

He is here today, as I understand it, at least in part because Dr. Merchant, who was scheduled to be with us, Dr. Eugene Merchant, is ill. And we hope that his recovery is speedy and complete, and we wish him well. And perhaps you could pass along our best wishes to him.

The second witness on this first panel is Dr. Ramchandrian Jaikumar, who is a professor at the Harvard Business School. Dr. Jaikumar, we are delighted that you could be with us today.

Gentlemen, if you would summarize your testimony, that would give us an opportunity to both ask questions of you and to hear from the other panelists. The testimony from all of you will be made a part of the record. Dr. Kegg, do you want to lead off?

STATEMENT OF DR. RICHARD KEGG, VICE PRESIDENT AND MANAGER, MANUFACTURING SYSTEMS DIVISION, CINCINNATI MILACRON, CINCINNATI, OH

Dr. KEGG. Thank you, Mr. Chairman. My name is Richard Kegg. I am associated with Cincinnati Milacron, a leading supplier of factory automation equipment, systems, and services.

My background has been 25 years of association with Dr. Merchant, who could not be here today, in the finding and acquisition of the world's best manufacturing technology, and making that available to Cincinnati Milacron's customers in the United States and throughout the world.

It has included the development of contacts and working relationships for technology transfer with leading researchers in the United States, the United Kingdom, Japan, West Germany, France, Hungary, Yugoslavia, and so forth.

My present task in the Manufacturing Systems Division of Cincinnati Milacron, is to sell, implement, and deliver complete computer-controlled flexible factories to our customers.

The subject of this hearing is very close to my heart. I personally, and speaking for Cincinnati Milacron, warmly welcome the interest of our national leadership in the task that is so important to us of making U.S. manufacturers and U.S. labor, U.S. engineering and U.S. management, world-class competitive.

Dr. Merchant has submitted a written position paper, which I have seen at the last minute and I fully support. However, I would like to paraphrase some of his statements and add a few observations of my own.

The current status of advanced manufacturing technology in the United States is that a few leaders in America, and a growing number, are adopting the latest technology. This is particularly true in the aerospace industry, and it is very significant that I say the aerospace industry.

And it is true here because past and present U.S. Government policies with respect to this industry have created an aggressive, competitive, technologically rich environment which is eager and able to try new things in their factories. This environment does not exist elsewhere.

A prime example is the LTV Aerospace Division in Dallas, TX, where the rear section of the B-1 bomber was manufactured ahead of schedule, under budget, with major cost-savings shared between the manufacturer and the Air Force as a result of a significant new computer controlled factory which was installed by that corporation and implemented and put into operation ahead of schedule.

Things are also happening to a lesser extent with nondefense industry. But it taxes their internal resources, and it taxes their will, the great effort required to adopt new technologies.

An example of this that I might mention is the Remington Arms Corp. in Olean, NY, a leading manufacturer of sporting firearms. This company, as many U.S. manufacturers, found international competitive cost pressures creeping up on them.

Rather than import, rather than move jobs abroad, they have created in Olean, NY, with U.S. management, U.S. engineering, and U.S. labor, a world-class computer-controlled manufacturing facility, using innovative labor relationships, innovative work assignments, and innovative manufacturing technology.

Here is clearly a case where we see that U.S. people can do the job and they can do it in a class that no one can exceed.

Generally in the United States the adoption of new manufacturing technology is slow. Most U.S. manufacturers are still struggling with the justification of CNC stand-alone machines, which is the last generation of technology, not the present. Why is this situation the way it is?

In manufacturing, we currently have an environment in which it is very difficult to institute changes. It is easier for me as a supplier of computer-controlled factory systems to make a half a million lines of computer code, and a dozen new robotic technologies, and put them together to make a product than it is for my customer to assimilate that technology and to use it profitably.

It is easier for me to make it than it is for him to use it. The environment for change is not good in U.S. manufacturing, with the exception of the aerospace industry. The American worker and American engineers are more innovative, in my opinion, and I believe with good evidence, than their counterparts overseas.

But it is only in the aerospace industry in the United States, as it is more broadly in Japan and West Germany, that the environment has been present to cause manufacturers to tap into that innovativeness and to use it and exploit it fully.

Another factor is that manufacturing has not been considered respectable for bright young engineers and entrepreneurs. Manufacturing has had an image in the United States, as opposed to other countries, of a disrespectable, dirty, low-technology way to make a living.

It has not been by our leaders, it has not been perhaps at times, in fact, a vocation that was attractive to bright young engineers. These factors combined to make U.S. industry, U.S. manufacturing, technologically-sparse rather than the technological richness of some of our international competitors.

Briefly, what kinds of things might Government do to change these factors and to move technology and U.S. industry in the right direction? First of all, I believe that general programs of encouragement of industry to move in this direction are in order.

We have seen the leadership of our competitor nations take strong public positions in support of the growth of industry, in support of the implementation of manufacturing technology.

In particular, I have not seen in the United States the political leadership take the kinds of positions that I have seen Mrs. Thatcher take in the United Kingdom.

Nor the kinds of things I see in the German engineering newspapers among the West German political leadership, helping to convince the public and to convince the entrepreneurs and the bright young engineers and the companies themselves, and encourage them in the proper directions. I have not seen this in the United States and believe it would have a significant influence.

Second, financial incentives of many different kinds are working for our competitor countries. Dr. Merchant has given many examples of how financial incentives have worked for our competitor nations.

Finally, I believe that one of the most direct things that fits with existing institutions that the Government could do is to stimulate entrepreneurship. One of the greatest ways to combat resistance to change and to cause the needed change to happen is through entrepreneurship. How can we stimulate entrepreneurship?

One of the ways that we can observe entrepreneurship helping our competitor nations is through the ring of growing small businesses located around and associated with world-class research centers.

As an example, I might mention the software companies developing manufacturing technology around Zurich, associated with the Federal Technical University of Zurich. I might mention the many entrepreneurial activities that have sprung up in West Berlin, associated with the world-class technological research center of the University of Berlin.

I might mention around the area of Stuttgart, the entrepreneurial growth companies that have grown up there creating jobs associated with the manufacturing community where young, bright entrepreneurial engineers are addressing aggressively the manufacturing problems of West Germany. Again, through association and stimulation with the Technical University in Stuttgart.

This kind of cooperation between the Government-sponsored universities, the research institutes, and industry, which works hand-in-hand with these institutes in these countries, creates jobs and provides an outstanding successful means of technology transfer.

In summary, I believe the opportunity is present today as never before. The reason is that we are in a time of rapid change of technology. The technology is available for a rapid transition from an inefficient, cluttered, uncontrollable method of manufacture into a smooth flow, chemical process-like method of manufacture.

This technology is generally available to all industrial nations. The country which creates the climate for the enthusiastic adoption of this technology will create the jobs and the wealth and the prosperity. The countries that do not create a climate or have a climate like this will be left behind. Thank you.

[The prepared statement of Dr. Merchant follows:]

STATEMENT

REGARDING MANUFACTURING AUTOMATION

By:

M. Eugene Merchant, Sc. D.
before the
Subcommittee on Innovation, Technology and Productivity
Committee on Small Business
Unites States Senate

December 2, 1987

Mr. Chairman and members of the Subcommittee. I am M. Eugene Merchant, Director, Advanced Manufacturing Research, Metcut Research Associates Inc. One of my continuing, principal responsibilities, of long duration, is to observe, first-hand, the progress of research, development and implementation of flexible, integrated, computer-based factory automation in industrialized countries throughout the world. It is from that background that I make this statement.

Automation and Competitiveness

Flexible factory automation is providing tremendous competitive advantage to those manufacturing companies which do an effective job of implementing and utilizing it. This fact is particularly true of small and medium-sized companies.

The competitive advantages which they are realizing include:

- Greatly reduced lead time from receipt of order to shipment of product (40%-60%)
- Greatly increased productivity of capital equipment (200%-500%)
- Greatly reduced work-in-progress inventory (30%-50%)

- Greatly increased level and consistency of product quality and reliability
- Greatly increased economy of producing great product variety in small (or even one-of-a-kind) lot sizes (economy of scope)
- Greatly improved ease of accommodation of design changes by production
- Greatly reduced uncertainty in overall operations
- Greatly increased ease of formalizing, employing and retaining expert knowledge
- Greatly reduced environmental and occupational hazards
- Greatly reduced product warranty costs (10%-35%)
- Significantly reduced capital investment per unit of product produced (10%-15%).
- Significantly reduced total annual costs (20%-30%)

The American Scene

The lion's share of the technology of flexible factory automation originated in the United States! Unfortunately, however, American small (and large) manufacturing industry has not done nearly as good a job in implementing and utilizing this highly advantageous technology as has that industry in several Asian and European countries, particularly Japan and the Federal Republic of Germany. This has been the case ever since the inception of this technology, which began with the origination of the numerical control (NC) of machine tools at the Massachusetts Institute of Technology in the mid-1950's. However, by the mid-1970's only a little over 1 percent of the machine tools in American industry were numerically controlled. Meanwhile, the Japanese manufacturing industry was already utilizing them more widely and West German industry was not far behind. As for small manufacturing companies, a 1975 survey of a representative sample of small and medium-sized manufacturing companies, carried out by the U.S. General Accounting Office, found that less than 18 percent of them owned even one NC machine tool.

The next major step beyond single, stand-alone NC machine tools, in flexible factory automation, was the integration of computer-numerically-controlled (CNC) machine tools into flexible manufacturing systems (FMS). Development and implementation of such systems had its beginnings in the late 1960's, primarily in the United States. By 1984 there were approximately 70 such systems operating in industry in this country, but almost twice that number in Japan. However, a confidential survey of over 100 representative small manufacturing companies (1-500 employees), carried out in part by Metcut at about that same time (1983-84), found no actual FMS in any of these companies. Furthermore, many of these companies did not even know what an FMS was. All this in spite of the fact that a flexible manufacturing system is, in itself, a small manufacturing factory!

Reason for U.S. Deficiencies

What are the reasons for such deficiencies in the use of the highly advantageous flexible factory automation which originated primarily in this country? I find these reasons to lie primarily in the realm of the poor environment for manufacturing which has developed in this country over the past 30 years. Some of the main elements of that environment are as follows:

- Virtual discontinuance of manufacturing-oriented engineering education by American universities since the Sputnik era, leaving us with an engineering population which is basically ignorant of the true realities of manufacturing
- Lack of adequate support of manufacturing research in American universities
- Lack of training of the existing manufacturing workforce in the technologies of flexible factory automation
- Lack of adequate mechanisms for transfer of advanced manufacturing technology from its sources, domestic or international, into civilian manufacturing industry
- Lack of adequate methodology for justifying capital investment in flexible factory automation
- Existence of a climate which encourages short-term profitability at the expense of long-term-oriented investment in advanced manufacturing technology in civilian manufacturing industry
- Lack of adequate direct or indirect government incentives to small manufacturing companies to implement and effectively utilize flexible factory automation
- Existence of a climate in industry, universities and government which characterizes shop-floor production (i.e., manufacturing in its narrowest sense) as a second-rate activity

- Existence of a climate of complacency in some parts of American industry based on the mistaken concept that our manufacturing industry is the best in the world
- Failure of the management of manufacturing companies to recognize and implement the team-type cross-disciplinary company organization, transcending departmental barriers, which is necessary for success in implementation and operation of integrated flexible factory automation.

If we wish to ensure the economic and social well-being of this country, then we must significantly improve its environment for the manufacturing industry--the creator of the basic wealth of the country--in the new era of manufacturing which has now dawned!

Foreign Government Programs

What have the governments of some other industrialized countries been doing to ensure an appropriate environment for their civilian manufacturing industry and its effective implementation and utilization of the new approach to manufacturing which flexible automation has brought us? I will sketch highlights of some of the programs and initiatives which various countries have supported or instituted, as illustrative of the types of approaches which governments utilize to create the desired environment

1. Federal Republic of Germany

- Traditional and continuing strongly manufacturing-oriented programs of engineering education in their universities

- Traditional and continuing strong government support, in cooperation with industry, of university-based manufacturing research institutes associated with the foregoing educational programs
- Significant government funding to the university manufacturing research institutes, targeted at advancing the technology of flexible factory automation and at transferring such technology to the civilian manufacturing industry and particularly to smaller companies
- Direct government funding of initial major manufacturing innovations in industry

2. United Kingdom

- An established Automation Division in their National Engineering Laboratory which carries out R&D on flexible factory automation and assists British manufacturing industry in implementing such automation, with particular emphasis on small companies
- Direct government grants to British civilian manufacturing companies, large and small, during the period 1982-85, to fund 50 percent of initial consulting costs and up to one-third of development and capital expenditures for implementation of appropriately innovative flexible manufacturing systems and robot applications. On the order of 20 FMS have been or are now being installed in British manufacturing companies, large and small, as a direct or indirect result of this program,

starting from a base of only 1 FMS (also government sponsored) prior to the program

- Establishment in 1985 of the Advanced Manufacturing Technology Center associated with the universities of Manchester and Salford, with the backing of the government Department of Trade and Industry (DTI) and the Science and Engineering Research Council (SERC), to carry out R&D and technology transfer of advanced manufacturing technology for British civilian manufacturing companies and government agencies, with particular emphasis on small companies
- The Teaching Company program, funded jointly by DTI and SERC, established in the late 1970's, to improve manufacturing engineering capability in British industry. In this, selected manufacturing companies, in partnership with selected universities, become "Teaching Companies" and provide, in manufacturing engineering, the high quality environment for career development and improvement in professional practice, for enterprising young engineers, that Teaching Hospitals provide in clinical medicine.

3. France

- An established government Agency for Development of Automated Production (ADEPA), with headquarters in Paris and field offices in each of the French provinces, whose role is to help small and medium-sized civilian manufacturing companies implement flexible factory automation in their own operations, through R&D, training of company personnel, and administration of direct implementation subsidies to companies

- A direct subsidy program, administered by ADEPA, initiated in the 1970's and carried on through the early 1980's to put flexible automation equipment (NC machine tools, robots, FMS, etc.) into small and medium-sized civilian manufacturing companies on a two-year trial basis, after which, if successful, the company could purchase the equipment at a price corresponding to its depreciated value. If not successful, the company returned the equipment to the supplier and paid him only for its depreciated value. The program was very successful in getting French manufacturing industry well onto the road to automation.
- A program launched in 1980 and expanded in 1982, carried out by what is now the Ministry of Industry and Research (formed by merger of two former ministries), aimed at focusing French R&D, engineering education and civilian manufacturing companies on flexible factory automation and machine tool engineering. It directed some 29 of the various French national laboratories to reorient large segments of their R&D programs toward advancement of FMS and robot technology. It directed French engineering colleges to develop educational programs in flexible factory automation and machine tool engineering and to establish close ties with manufacturing companies and machine tool builders. It provided direct funding to some civilian manufacturing companies and machine tool builders to develop

and implement a few advanced flexibly automated systems. At its height in 1984, the overall program was purported to have proposed funding of over $100 million per year. However, it appears that much of that funding failed to be authorized and that by 1985 the program had crumbled to an appreciably lower level.

4. Sweden

- Traditional and continuing strong government support of manufacturing-oriented engineering education, and manufacturing research institutes, in their universities, in the general mold of the similar programs in the Federal Republic of Germany
- An ongoing program, initiated in 1984, aimed at assisting Swedish civilian manufacturing industry in implementing integrated flexible factory automation, to combat heightened competition from Japan. This provides direct financial support to civilian manufacturing companies carrying out innovative projects of implementation of flexible factory automation, with 50 percent of funding for these coming from government (to be reimbursed to the government over a period of years) and the remainder from the company. In addition, the government also funds university manufacturing research institutes to work with funded companies to transfer the needed technology and to help solve technological problems.

5. European Economic Community

- An ongoing program, as a subprogram of the EEC Commission's European Strategic Program for Research and Development in Information Technology (ESPRIT), known as the CIM Subprogram. Initiated in 1983, the program aims to motivate and assist civilian manufacturing companies in EEC countries, through inter-country partnerships and in cooperation with universities, to develop and implement integrated flexible automation of their own operations and to develop advanced flexible factory automation products, to gain a competitive edge over U.S. and Japanese manufacturing industry. Project funding amounted to some $100 million for the first five year program and that for the coming five year program is expected to be considerably larger.

6. Czechoslovakia

- Traditional and ongoing strong support of government-operated institutes for manufacturing R&D and engineering, providing, in cooperation with Czech universities, assistance, training and technology transfer to Czech civilian manufacturing companies in the implementation and operation of flexible factory automation
- A series of five-year programs to develop prototype flexible manufacturing cells and systems, starting in 1975. The 1980-85 program with funding of some tens of millions of dollars, half from government and half from six participating machine tool

companies, administered and technologically supported by the national Machine Tool Research Institute, developed six prototype advanced flexible manufacturing cells and systems. These are now operating in those companies, with the companies now repaying the government for the funds it committed to them. In the 1985-90 programs, a full line of intelligent unmanned flexible manufacturing cells, capable of being integrated to form FMSs, is being developed by cooperation between the national Machine Tool Research Institute and a group of participating machine tool companies, again with funding of some tens of millions of dollars, half of which is from government on the same terms as in the previous five-year program.

7. Hungary

- An ongoing program of the Computers and Automation Institute of the Hungarian Academy of Sciences to assist Hungarian machine tool builders in their development and implementation of intelligent, unattended flexible manufacturing cells and systems
- A five-year, well-funded program launched in January, 1986, aimed at promoting the application, in Hungarian civilian manufacturing companies, of integrated flexible factory automation, and at establishing, in Hungarian universities, complete manufacturing systems engineering curricula. Approximately half of the funding will be from the Hungarian

government, with the remainder coming from the Hungarian manufacturing industry.

8. Japan

- Continuing strong government support of manufacturing R&D, for benefit of the civilian manufacturing industry, in the government's Mechanical Engineering Laboratory and Electrotechnical Laboratory
- Continuing strongly manufacturing-oriented programs of manufacturing engineering education in Japanese universities
- Planning and coordination of university, industry, and government laboratory manufacturing R&D programs by means of a network of Joint Research Groups, funded by government and industry, and faithfully participated in by representatives of all three
- Direct government funding of initial major manufacturing innovations in civilian manufacturing industry, such as the first Japanese FMS
- Special tax incentives to civilian manufacturing companies for acquisition and implementation of high technology manufacturing equipment and systems
- A special national R&D project, carried out over the period 1977-85, which successfully developed and demonstrated a very advanced, prototype, fully automated, fully integrated flexible manufacturing system complex for small lot production of mechanical products, from raw stock to assembled, inspected

products. This was a joint industry, university, government project, with some $60 million direct funding from government and about twice that much direct and indirect funding from the participating manufacturing companies. Its most important result probably was the very strong incentive which it gave to both the participating and the non-participating civilian manufacturing companies to move as rapidly as possible to develop their own "unmanned" factories and have them in operation even before the demonstration project was completed.

The outstanding overall theme of all of the national programs is their emphasis on cooperation between industry, universities and government in support of civilian manufacturing industry--the creator of the basic wealth of a nation.

Senator LEVIN. Thank you very much, Dr. Kegg. Dr. Jaikumar.

STATEMENT OF DR. RAMCHANDRAN JAIKUMAR, PROFESSOR, HARVARD BUSINESS SCHOOL, BOSTON, MA

Dr. JAIKUMAR. Thank you, Mr. Chairman, and Members of the Subcommittee, for inviting me to testify on the opportunities and problems facing small business.

I teach at the Harvard Business School a course on technology policy. And I have been doing research on the use of automation and the use of technology in firms, and how they use it for competition for competitive purposes.

Senator LEVIN. Could you pull your mike close, Dr. Jaikumar?

Dr. JAIKUMAR. And in my studies, I have been focusing principally on the most advanced forms of these technologies, the flexible manufacturing technologies, as they are called. And I have found that there are big differences in the way they get used in Japan and in the United States.

As Dr. Kegg mentioned, we have the technological capability, we have some of the best engineers and some of the best technology available. But when it is put to use somehow, it does not get used effectively for competitive advantage.

In my testimony I classify different kinds of technologies, its implications to management and to competition, why they have not been adopted as much as we would expect in small business. And I also offered some recommendations for policy steps that might be taken.

And while Senator Levin, in his opening remarks, had mentioned the problems associated, I could not help looking at the flip side of it and think about the tremendous opportunities which in fact are present with these technologies, and which we are in a better position in many ways than most of the other countries, including Japan.

And let me say why that is the case. The early part of this century, when mass production was introduced in America and was innovated over here, we basically took over technological leadership and manufacturing leadership throughout the world. And mass production was a step change from anything that happened before that.

Now we are finding there is another technology which is coming up, which is the integration of information processing with material processing. The putting together, bringing computers and material processing together. And that is fundamentally changing the structure, not only of the firm and how things get produced, but also the composition of the industry itself.

For instance, if you look at the automotive industry, the number of small businesses where two or three CNC machines, very small but very versatile machines, which has information-carrying possibilities in Japan, are significantly greater than the machines, the composition in the United States, in the automotive industry for instance.

Another big change you find is, if you walk into a factory in Japan, over 40 percent, 40 to 60 percent of the workforce are engineers. And if you walk into a factory in the United States, you will find anywhere between 5 to 10 percent of engineers on the shop floor.

Both the composition of the workforce and the nature of the technology gives them an advantage. And this advantage is small, meaning, small businesses, and the automation if available for small businesses, which is different from the earlier form of automation which took place in the early part of this century where it was mass production and high volume and big business.

And we have been essentially living in the world of—we still think in terms of mass production and still think in terms of large enterprises in the last generation of automation.

The CNC machines, for instance, we in the United States have not taken this technology, tried to standardize it, and essentially market it to the small firm, to the small businesses. In effect, bringing this technology to reducing the scale, bringing it small. And in fact, we have lost that market.

The machining centers, turning centers, the machine tool industry for the small-scale, small businesses, we have lost that market. And I think it is changing. I think it is changing today.

There is greater recognition that we have to focus these things for small-scale enterprise and it will change. What this technology does is, it is extraordinarily flexible. You can make a wide variety of components, very precise.

The degree of precision and quality you can get out of them is much higher. And the image, which is useful to think about in seeing what the potential is for the future, is one machine working throughout the night without anybody around. A person can start the machine at night and come back next morning, and the parts will be done.

Why does that system work? For one thing, it is computers through a different set of programs which looks at every possible thing that can go wrong in processing, adapt for it, correct for it, and produce parts. So it is the integration of information and materials processing.

At the same time, it changes the skill base. The person writing these programs has to be skilled, not only in the technology of making something but also in the skills of abstracting and writing procedures, writing computer programs.

The extent of computer illiteracy in small businesses in the United States is very, very big. We do not have a computer literate workforce, which we can rapidly expand on. And that is another big difference between the United States and our competition in Japan, and Germany for that matter.

In order for this, again, this picture which I put in earlier for a machine running by itself at night, stand-alone, just a single machine, what you need to do is write a program before the first part is produced.

You need everything. The tools, the fixtures, the programs, all set before the first part is produced. And once you have written that, whether you make one or whether you make 500, it is the same cost. Which means most of the costs are sunk before the first product is made.

What that does is the conceiving of the procedures and the making of it, and the execution of these procedures are separated.

Take the other extreme. Suppose I have this program and could transport it remotely to another machine someplace else in the country.

Theoretically the technology is in the labs today, and you could have it soon, where transportability of these, as long as the standards are established, could be done. There is use of transportability.

And you could conceive of a person writing a program in one place, debugging it, making sure that everything is working, and then after having produced X number of units, could transport it anywhere in the world, and get it made.

If that is the case, if you think of the conception and execution as separated, people who execute procedures, companies which have these machines will essentially be selling capacity, which means it becomes a commodity. Capacity becomes a commodity. And people who conceive of these programs are the ones which we will create economic premium, if you will.

Which means that small businesses which are skilled in creating new programs, new procedures, new products, in effect, innovating, are the ones who would succeed. And people who are essentially executing, they will be selling capacity.

That structure is particularly suited for us in the United States. We are good at innovating. We are good at building. We are good at improving.

But we need to build technologies by which this transportability, this standardization of software, protocol standardization of machine tools has to be doubled up in order for us to get these advantages. That is one big difference structurally, if you think about what is going on.

The other big advantage, another big difference is scale. These things can take place in the small. Innovation takes place in the small. Learning takes place in the small, while execution, the commodity aspect of these things can take place in the large.

Scale economics is no longer the driving force in these kinds of technologies we are talking about. If you remove scale and you say that this automation is particularly relevant to the small-scale industries, and also if you say that innovation is the name of the game to be competitive, and that is where we get premiums, it is very well suited to the structure of the U.S. industry, particularly for small businesses.

Then the question is, why is there not today? Why have we not taken this thing and run? One of the things for these technologies to work, every aspect of the system, the software, the machine tools, the computers, the literacy, all have to come together. And there is not one vendor who could supply all of that.

And small businesses are much too small for them to do it on their own. So there is a peculiar form of market failure where the market has not been able to double-up the systems for the small scale.

And the small business, particularly in the realm of standardization, standardization of protocols, there have been efforts recently to bring those things in. But that has not happened as yet. And we need to build on that to get rid of that kind of market failure.

And the other difference is, most of the systems that we have built have been built for the medium- and large-scale businesses and not the small businesses. And these kinds of technologies are particularly suited to the small business.

One thing which comes up a lot besides the nonavailability of small business is, why does not small business invest more in these technologies? Partly because of technological uncertainty.

They do not know what the next new technology is going to be. And small businesses essentially, when they invest in machines, are investing in additional capacity. They think of it in adding capacity. Not in replacing obsolete capacity.

That is a mindset in small-scale industries, is whenever they have to add they say, I have already got the machine. I have the capacity. Why should I buy a new machine? They do not think of it in terms of restructuring of existing capacity.

And there are not skilled people. There are not skilled people for them to go and hire. We do not have a computer-literate workforce from which small businesses can hire. And for larger businesses to create these skills is another form of market failure.

Because they see training them, and as soon as they have trained these people they go away. They go to another company. And so they spend all this money creating the skills, and find that people leave.

And so there is a tendency not to create enough of these skills. Maybe just enough for their own needs. But not a lot. That is another area that we have to get around. We have to create the different kind of workforce in order to take advantage of these technologies.

So, the third reason why I find small businesses not adapting to some of these technologies is that they feel their competition is next door. If the guy next door does not have these, why should I? Let somebody else try it first. And then if it works out, then I will try it.

They do not think of competition as a shop in Japan. They do not think, broadly speaking, as a result they are gradually losing these parts production in the United States to companies in Japan.

And unless we get the realization that the competition is not the shop next door, it is a shop outside someplace else outside in the world, and create the environment of technological competence that we need to build competence, and we need to be competitive technologically throughout the world, and the way we do that is not just adding capacity, but rejuvenating the technological base itself, I do not think we can go very far. And that is the place where, I think, policy would clearly help.

Now, given that there is this market failure, we do not create the skills, we do not create the technologies for the small businesses because it does not pay for one single person to do it, how could we solve that problem?

I have been particularly impressed with the textile industry in Italy, where we find the same kinds of things that we are talking of today take place in the textile industry early on, where scale economies gradually broke down, a lot of technological innovation.

And we still find very, very small companies. Five or six people. If you look at the Prado district in Italy, you will find the average firm size is seven people. And you have 15,000 firms.

And how do they compete? They compete with the Burlingtons, they compete worldwide, with the Japanese. And they have been extraordinarily successful.

The way they have been able to do that is, each small firm specializes in certain aspects of textile production. And there are a number of them. And constantly bringing new technology.

The rate of introduction of new machines in the textile industry in Prado is one every 8 years. They just move machines, which is more than any other country, more than any other textile company that I know of.

The other thing that they do is they are very close to the market. They know what is going to sell. They know what is happening in New York. And they are constantly innovating, bringing out new fabrics, new processes, new products, and are in very close touch with the marketplace worldwide, through different intermediaries.

That is not to say that each seven-person firm has a representative in New York. But it is through these coalitions that they form these groups. And it is very, very competitive.

But what happens is, there is a dynamic where we have to cooperate in one dimension and compete in another. And we in the United States have not been able to build structures which manages to bridge that. Trying to cooperate, and at the same time trying to compete.

They have been very successful in building institutions which provide for that training. For instance, everybody pays for training jointly. And also the savings institutions make sure that the financial resources are invested in the same district, in the Prado district.

And so there is some form of insurance in the sense that people, the small businesses, even though they go bankrupt, the people involved will not lose jobs. The downside risk is very low. And there is a big upside potential.

The financial incentives to succeed are high, but the downside risk is very low. And wherever there has been a market failure, like in training, like in access to intelligence, market intelligence, and technological intelligence, there have been cooperative institutions that have taken care of that.

And that is true in the Japanese subcontracting system in the automotive industry as well. The same kind of market failure works in Japan. Why have they been able to succeed?

They have been able to succeed simply because the coordination between the machine tool industry in Japan and the automotive industry in Japan in the early 1980s made sure that a number of small businesses were trained, and they pushed technology down, CNC technologies down. And with the active collaboration of the Government as well.

And I think those are the kinds of institutions we have to think about to create the technological competence of the small business industry, standardization, so that we can get this kind of transportability. And also to create some kind of a market which does not exist today.

And let me elaborate on that a little bit, which I have talked in my testimony about. The aerospace industry which Dr. Kegg mentioned, we do have the most advanced forms of automation. They have adapted that and used it very, very effectively.

But it has just stayed with the aerospace industry and only with the big actors. That technology has not gone down to the smaller businesses which support the aerospace industry.

And one of the ways I think we could get that technology down is to make sure that in the subcontracting procedure we have these programs completely transferable to small businesses as well. And so a much greater degree of small business participation in DOD subcontracting procedures.

And I think it is possible, I think if we standardize the technology more, we standardize software protocols, that a lot of the components presently made by the big players in the different industries can go down to a larger base, which will increase the technological competence as well as increase the market for goods in the small-scale and other sectors.

I have elaborated a little bit on those things, and I am prepared to answer any questions you might have. Thank you.

[The prepared statement of Mr. Jaikumar follows:]

STATEMENT OF
RAMCHANDRAN JAIKUMAR,
PROFESSOR,
HARVARD BUSINESS SCHOOL

BEFORE THE
SUBCOMMITTEE ON INNOVATION, TECHNOLOGY, AND PRODUCTIVITY
OF THE
SENATE SMALL BUSINESS COMMITTEE
U.S. SENATE

DECEMBER 2, 1987

Mr. Chairman and members of the committee: thank you for inviting me to testify on the opportunities and problems facing small businesses in automating their manufacturing processes.

For many years, now, I have been studying the impact of some of the newer information-intensive processing technologies on manufacturing, and how that impact might be reflected in the industrial structure and the nature of competition. We are seeing a fundamental restructuring of industrial production. As I shall show, the role of small business is at the heart of a new model of industrial production, which I call "Dynamic Competitive Coalition," that I see emerging in a wide range of industries. I shall try to acquaint you with the patterns I have observed, with what we have to do to get where I think we should be going, and with what policy steps will take us there.

In this brief presentation, I will attempt to do four things: 1) acquaint you with the fundamentally important features of the new form of automation -- microprocessor-based automation -- that distinguish it from previous forms of automation; 2) describe the economic and managerial implications of learning the new technologies associated with flexible automation; 3) explain what is standing in the way of their adoption by small business; and 4) offer some recommendations with respect to policy steps that might be taken to remedy the situation.

THE NATURE OF THE BEAST

Flexible automation differs in several important ways from the automation we know as the legacy of the industrial revolution. First, it integrates information and material processing; these are very much separate in traditional technologies. Second, it relies on greater machine intelligence; traditional automation relies on the intelligence of machine operators. Third, it affords flexibility, precision, productivity, and versatility simultaneously; traditional technologies typically provide one of these at the expense of another.

These differences give rise to the most important characteristics of microprocessor-based automation. The first of these is flexibility. Microprocessor-based automation has led to the development of machines markedly different from those of traditional automation, which are designed to churn out one thing in enormous quantities. The machines of microprocessor-based automation can produce a little of this, a modest batch of that, and a bunch of those -- and they operate most efficiently in small groups. This absence of economy of scale makes microprocessor-based automation directly relevant to small business.

The other important characteristics of flexible automation come out of the tight integration of information and materials processing. In a flexible manufacturing system, or FMS, the process of production is under the "complete" control of computer programs. Product and process specifications exist as computational procedures that are fed into these programs. These specifications must anticipate every possible contingency, that is, every potential problem with the product and process has to be thought through in advance and solved for. The consequence is that once it's done right, it doesn't ever have to be done again. Every part made using a particular set of specifications will be exactly the same as every other part. This is *precise reproducibility*, and it is achieved by the highly skilled people who write the procedures. In this context, firms are distinguished primarily by the software and programs available to them, as these determine the range and type of products they are capable of manufacturing. Consequently, a firm's intellectual assets, that is, the people who write the procedures and resolve the contingencies of production, become more valuable than its hardware.

The existence of procedures also contributes to the *transportability* of product and process information, as software can be moved both physically and via telecommunications. Stored specifications enable one to produce an identical part on any one of many different machines in many different places. With computer communication, such procedures can be used to control production at locations remote from the place where the procedures are run.

THE INDUSTRIAL BASE -- A NEW LOOK

In what follows, I am taking the perspective of the most advanced form of microprocessor-based automation, flexible automation, in order to illustrate the kind of environment we are moving toward. Thinking about what the future may very well look like can help us better understand the issues involved in getting there.

One thing that has changed significantly is scale. Size is no longer a barrier to entry. The minimum efficient scale for FMS operation is a cell of roughly six machines and fewer than half a dozen people. FMS operation does not require lots of money or people. It can be done -- at its best it is done -- on a small scale. Once in operation, the system has a number of distinct advantages: it can be used to make many different products; it is adaptable to changes in product design; it allows untended operation.

The nature of flexible automation requires that investments -- in people, tools, fixtures, and software -- be made up front. Thus, when a new part has to be produced, practically the entire cost of the system is sunk before the first unit is produced.

Once the procedures have been written, the versatility of the machinery and easy transportability of the programs allow the products to be produced by anybody. The market for production capacity would become very competitive, and thus a commodity.

Hence, any premium that can be extracted by a firm is in the creation of new procedures for improved processes and products. Firms would thus compete by constantly trying to introduce new products and create performance advantages. These "learning economies" are best achieved in small innovative organizations.

The characteristics of level of scale economies, separation of conception and execution, easy transportability of procedures, and competition based on innovation will lead to the radically different industrial structure that I earlier referred to as dynamic competitive coalition.

These technologies have the potential of increasing manufacturing performance by an order of magnitude. In a recent paper (copies of which accompany this testimony), I chronicled dramatic increases in productivity already realized from flexible manufacturing systems in Japan. In that paper, which explores the managerial imperatives of this technology and outlines the structure of competition in the postindustrial world. I have documented, for a given level of production, five-fold reductions in labor, reductions by half in the number of machines required, and increases in machine utilization of more than 20%. I have recorded delivery performances of 100% over a three-month period, unscheduled system downtimes of 2%, and quality problems at the level of .006%. Such impressive levels of performance free executives to attend to meeting competitive pressures on product performance, rather than to the day-to-day performance of the machines that make the products. These technologies dominate existing modes of production, and, in the long run, we have no choice but to adopt them.

Despite this potential, microprocessor-based automation, in stark contrast to its significant penetration in Japan and parts of Europe, is a negligible factor in U.S. small business. Its adoption has been lamentably slow here; easily most of U.S. small business remains woefully computer-illiterate. More than half of all the N/C machine tools sold in the world are bought by Japan, and, of these, more than 60% are acquired by small businesses. More than 40% of the workforce operating these sophisticated machines are graduate engineers, and the remainder are technically well-qualified.

The composition of the workforce is among the many things in the manufacturing environment that will change dramatically as new automation technologies are increasingly adopted. The manufacturing workforce will be much smaller in size, and require multidisciplinary skills of a high order. In a manufacturing world of zero defects and extremely high reliability, manufacturing expertise will move from a craft to a science. The education requirements of such a scientifically trained workforce should be of paramount concern to this committee.

FOREGOING THE PROMISE

Why this paradox? Why, with demonstrated increases in productivity of 5:1; with orders of magnitude increases in reliability, quality, and flexibility; and with global competitors making the most of these benefits, are we not availing ourselves of these technologies?

There a number of answers.

1) The major benefits of microprocessor-based automation will accrue only to those who replace their entire system of production with highly integrated systems that link production control and inventory, computer-aided-design (CAD), support software for writing and debugging programs, and an infrastructure for maintenance. Any change less than this will yield only small, if not insignificant, benefits. The small steps that small business is taking today will yield only such incremental benefits, and the return on investment, because of the high cost of installing the systems, will seem low. This uncertain return on investment will keep them from taking *all* the steps necessary to reap the "big" benefits at the end.

2) Absence of standards creates a climate of technological uncertainty. Systems offered by different vendors are seldom easily integrated. Add to this the rapid pace of evolution in technology, and it's easy to see why many potential users are adopting a "wait-and-see" attitude before making major changes. A related problem, a very real shortage of trained people, derives from flexible automation's requirement for skills quite different from those relevant in the old paradigm. At present, these skills, where they exist, are expensive, and managers are not sure how to manage them. The rapidity of technological change further complicates the situation by rapidly making obsolete

existing skills and knowledge. The means to promulgate these skills and keep them current, at a cost that small businesses can afford, is sorely lacking.

3) There is a serious lack of understanding of the global implications of microprocessor-based automation. Too much of small business still thinks too locally. Businesses that view the competition as the "shop next door" are unlikely to effect dramatic changes in the way they do business as long as there is no noticeable change in the neighborhood.

4) Finally, there is market uncertainty. Small business tends to view investment in new machines as adding capacity rather than rejuvenating process capabilities. Consequently, in an uncertain economic climate, small businesses are inclined to presume sufficient capacity to take care of existing business, and reluctant to invest in new systems and machinery.

These answers help to explain why customers haven't adopted microprocessor-based automation, but, if the promised potential of these technologies is truly believed, why haven't the market forces worked? Why haven't the vendors developed simple, standardized, stand-alone systems that can be sold in volume, and marketed them appropriately? This is, after all, what our competitors overseas are doing.

1) First of all, there is no one vendor. There are controller builders, computer systems manufacturers, machine tool builders, and software houses, and the latter two are highly fragmented industries. Computer systems manufacturers tend to be large firms, like IBM and DEC, that do not understand the idiosyncracies of machine tool design and mechanical processing. The result of these circumstances is a plethora of systems that cannot be easily integrated and do not communicate with, or "talk to," one another. It is unclear how a fragmented industry without standards can build integrated systems for small business.

2) Notwithstanding that microprocessor-based automation is devoid of economies of scale, U.S. vendors have focused on applications for big business; present systems are large and each installation typically requires customization. The vendors of these systems do not *want* to target small businesses. The only vendors who sell to the small business sector are foreign machine tool builders, specifically, the Japanese, and the systems they sell, usually stand-alone machine tools, are not compatible and consequently not easily integrated with the rest of the customer's business systems. Without the links to CAD, to inventory, to materials and management systems, etc., that is, without the substitution of a completely integrated system for existing production facilities, the full potential benefit of microprocessor-based automation cannot be realized.

3) It shouldn't be surprising that there is no groundswell of demand from small business for systems that don't exist, but lack of demand for systems is also lack of incentive for joint ventures or collaborative arrangements that might produce the relevant standards and systems. There has to be a move from the development of dedicated systems to development of a more standard set of systems and procedures before *vendors* will see any benefits.

4) Finally, there is no benefit to the prime mover among these systems builders who establishes the standards, only a huge investment in time, effort, and money. The transportability inherent in the technology makes proprietary control difficult, setting the stage for everyone else to come along and reap the benefits through rapid

duplication. Hence the reluctance of systems builders to be the first to innovate.

LEANING ON GOVERNMENT

This is the riddle of the chicken and the egg. The market has failed to solve it. Should government try?

It should if it wants small business in this country to survive. The constituency is large and significant, the industries concerned, extensive. The unique characteristics required to compete successfully in the emerging industrial structure are particularly suited to the social conditions in the United States. We should at least examine what might be done to make this considerable sector more globally viable through microprocessor-based automation.

Given the interest of government, what policy steps might be taken?

Let's first review the circumstances that we are trying to address with any policy that seeks to promote the adoption of new automation technologies. As we have observed, the evolution of information intensive industries is eroding the importance of economy of scale, causing competitive advantage to shift to smaller organizations that occupy distinct technological niches and use the rapidly expanding communications infrastructure to compete worldwide. I believe that this model represents what will become the dominant mode of competition in a number of industries.

To set up in this new environment does not require enormous amounts of capital, and the firms that do so need not be capital intensive. Success in this environment hinges on a firm's understanding of market needs and its capacity to learn and innovate. Given the relatively low cost of entry, the cost to the economy of the failure of any one enterprise is small. Success, on the other hand, would make an enterprise competitive anywhere in the world.

I have summarized the policy requirements that would facilitate the emergence of this new environment in the set of principles for the model of dynamic competitive coalition. The relevant tenets are:

(a) An infrastructure of education and training in a coherent class of technological niches, defined as broadly as desired.

(b) Close informational links with world markets and immediate access to technological developments that might affect these niches.

(c) A system to support the development of a number of small organizations leveraged around a few technical experts guided by a philosophy of letting a "thousand flowers bloom."

(d) A scheme that fosters high upside potential while minimizing the downside risk for failure.

Next, it is necessary to consider at what level government policies should properly be effected, whether in a firm, among a coalition of small businesses forward integrated into a few large firms (the Japanese model), or in a cooperative between competing firms.

Some successful models built on the principles set out above are: the structure of the textile industry around Prato, Italy; the Japanese subcontracting system in automobile production; and the Agricultural Extension Service in the U.S.

ONE CRUTCH OR TWO?

Given the need for federal succor, and assuming a willingness to provide it, what form should policies designed to promote small business's adoption of automation technology take? I offer the following recommendations.

1) *Establishment of standards for software communication and machine intelligence.* Provide the necessary funding to enable the National Bureau of Standards to play a stronger role in the necessary standards-setting activities that must occur. We need standards that address communication between machines and systems, that acknowledge issues of integration and greater intelligence in computer-aided-manufacturing systems, and that are easy to access, easy to use, and non-threatening. These would necessarily take the form of different sets of standards for different sectors of the industry. It would, for example, give machine tool builders a set of standards to build to, software houses a set of standards to develop to, etc. Most importantly, though, we need the *right* standards.

2) *Continual learning as a social good.* Labor markets for the kinds of skills required are not efficient today, considering the need for continual skill revitalization. There is no private incentive to re-create these skills, which is even more a problem for small business, which can afford neither to create nor to buy them. Yet, there are clear social benefits to creating these skills, and we need to consider alternatives for doing so. I propose that funding be provided for the establishment of regional vocational training institutes provided with access to the latest microprocessor-based manufacturing technology and charged with developing computer literacy in manufacturing and establishing lifetime learning programs. Without the availability of such institutes, which are capable of regenerating new skills in a technologically dynamic world, small businesses will be unable to either train or keep technically skilled people.

3) *Enhancement of Federal contract procurement practices.* I suggest that you examine Federal contract procurement with the idea promoting greater involvement by small business in the manufacture of components. Provided with the latest, and standardized, technology, small business could create and use easily transportable programs and provide a much broader base of suppliers, which would make subsequent contract procurement more competitive. DOD, in particular, would clearly benefit from transportability of programs across vendors. Uniformity, standardization, and transportability are necessary preconditions to any mobilization effort. The technology for this to happen is not here yet, but neither is it far off. The number of components for which this could be realized is very large. While a number of attempts have been made to increase the participation of small business in the production of piece parts, they have not included incentives for greater transportability. We need to have an order of magnitude increase in the base of production for every single "commodity-like" part to make the market truly competitive. I suggest that private brokering agencies be established with the sole objective of creating efficient markets. Moving in this direction is at once in the national interest and in the interest of reducing market uncertainty for small business.

4) *Regional cooperatives and an Industrial Extension Service.* I realize that the present mood of the country is not one for spending more money or creating new

institutions, and that the idea of an "Industrial Extension Service" may smack of the New Deal era, but I believe that it is important, and urge that it be considered. We can examine a variety of forms such an institution might take. I am not in favor of monolithic institutions, preferring, instead, structures that resemble the textile districts in Italy. These districts have all the characteristics we mentioned in the model of dynamic competitive coalition, and, though each firm is very small (numbering five to ten people), they are globally competitive. The aggregation of specialized firms within a framework in which each cooperates as well as competes with the others creates a structure that has the features of large scale enterprise. Competition among the constituent firms provides market benefits, while the cooperation that creates the individual districts avoids the market pitfalls mentioned earlier, and creates social value.

The idea of an Industrial Extension Service was discussed in the Technology Capabilities Act of 1987. I envision the institution being built on the model of the Agricultural Extension Service. Its function would be to to coordinate across a number of small business-dominated industries, and make available to them intelligence on the latest available technologies. Such an agency would have the necessary breadth and scope to carry out a national program for promoting the adoption of automation technology by subsidizing equipment purchases or leasing equipment at nominal fees for periods of as much as a year, by encouraging and supporting more localized (state or county) cooperative ventures, and by providing training and the resources that would enable others to train. It could encourage the development of modular software, as for inventory control, product design, process cutting, etc., that is "friendly" enough to be used by unsophisticated users, and make the software available on a cost-of-training basis.

If you ask why such a service, if valuable, might not be provided commercially, my answer is that, at least in the beginning, it does not have the returns. Given the client base we want to support, the charge for such services necessarily has to be small, a condition that can only be accommodated by government funding. When the infrastructure is sufficiently well established to make the service commercially viable, we might think about privatizing it, if appropriate. Issues such as what constitutes a qualified user are mechanics that could be worked out once the concept is found to be effective in principle.

Current efforts by the Department of Commerce and the National Bureau of Standards to develop cooperatives that would make FMS, and training in its use and management, more available to small businesses are inspired but insufficient. The cooperative concept will have a major impact only if it is conceived on a larger scale than is the case at present. To secure global competitiveness for the small business sector requires a much more ambitious program, the kind of technological push that was clearly encouraged by the automobile industry in Japan, when it sought active collaboration with machine tool builders.

Financial incentives, though perhaps initially tenable, should not be the focus of automation policies. I believe a more viable strategy is to (1) create the technologies that will make products cheaper and more easily available, and (2) institute mechanisms that pool financial risk over a number of small firms, thereby reducing the risk for individual firms in the portfolio. Some form of insurance, whether public or private, would greatly increase access to capital for small firms. What financial incentives are offered as a stopgap measure should probably be capped, except, perhaps, as provided in the form of tax incentives.

These are my answers to the chicken and egg riddle. This is how I propose that the cycle be broken. We can't transform U.S. business overnight. We can't introduce the latest automation technology universally and all at once. We don't yet know what standardization really means. Nor modularity. These things will come out of the necessarily slow process of incremental introductions that will take us toward fuller automation, with its substantial benefits. And it is because we have to move slowly, and accept as a result the smaller incremental benefits of these technologies, that we vitally need government support.

I have stressed how important these issues are to small business and how important small business is to the U.S. economy. It is important to keep manufacturing in this country. Inasmuch as three-quarters of manufacturing output comes from operations with fewer than fifty people, that means keeping small business alive in this country. I commend this committee for initiating a serious debate on this important national issue, and hope that some of my observations will be useful to you in your deliberations. If I can be of further service to you as you delve deeper into these issues, I shall be happy to cooperate.

Postindustrial manufacturing

Ramchandran Jaikumar

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Reprint number

69 Postindustrial manufacturing 86606
Ramchandran Jaikumar

77 The manager: master and servant of power 86603
Fernando Bartolomé and André Laurent

82 Of floating factories and mating dinosaurs 86609
Alonzo L. McDonald

87 Tap your subsidiaries for global reach 86602
Christopher A. Bartlett and Sumantra Ghoshal

95 Will services follow manufacturing into decline? 86611
James Brian Quinn and Christopher E. Gagnon

106 James Callaghan: the statesman as CEO 86605
An interview by Alan M. Webber

113 Marketing subversives 86604
Thomas V. Bonoma

119 Destructive trade-offs in U.S. trade policy 86610
D. Quinn Mills

125 Good supervisors are good supervisors – anywhere 86607
Janice A. Klein and Pamela A. Posey

For the manager's bookshelf

6 Dr. Kaufman's guide for the perplexed N A
George Sim Johnston

Getting things done

12 The economics of real estate decisions 86608
Christopher A. Manning

Growing concerns

24 When partners fall out 86614
Philip H. Thurston

From the boardroom

38 The invisible director on corporate boards 86601
Clayton P. Alderfer

Ideas for action

56 Game plan for business coalitions on health care 86612
Mark Reisler

64 Fund-raising lessons from high-tech marketing 86613
Henry E. Riggs

Postindustrial manufacturing

Ramchandran
Jaikumar

As global competition grows ever fiercer in manufacturing industries, American managers are adopting a new battle cry: "Beat 'em with technology or move–over there." Indeed, since 1975, the boom in information-intensive processing technologies has been explosive. A close look at how U.S. managers are actually using these technologies, however, silences their battle cry in a hurry. Yes, they are buying the hardware of flexible automation–but they are using it very poorly. Rather than narrowing the competitive gap with Japan, the technology of automation is widening it further.

> ***"Flexible automation shifts the arena of competition from manufacturing to engineering."***

With few exceptions, the flexible manufacturing systems installed in the United States show an astonishing lack of flexibility. In many cases, they perform worse than the conventional technology they replace. The technology itself is not to blame; it is management that makes the difference. Compared with Japanese systems, those in U.S. plants produce an order-of-magnitude less variety of parts. Furthermore, they cannot run untended for a whole shift, are not integrated with the rest of their factories, and are less reliable. Even the good ones form, at best, a small oasis in a desert of mediocrity.

Lest this sound unduly harsh, consider the facts summarized in *Exhibit I*. In 1984 I conducted a focused study of 35 flexible manufacturing systems (FMSs) in the United States and 60 in Japan, a sample that represented more than half the installed systems in both countries. The kinds of products they made–large housings, crankcases, and the like–were comparable in size and complexity, and required similar metal-cutting times, numbers of tools, and precision of parts. The U.S. systems had an average of seven machines and the Japanese, six.

Here the similarities end. The average number of parts made by an FMS in the United States was 10; in Japan the average was 93, almost ten times greater. Seven of the U.S. systems made just 3 parts. The U.S. companies used FMSs the wrong way–for high-volume production of a few parts rather than for high-variety production of many parts at low cost per unit. Thus the annual volume per part in the United States was 1,727; in Japan, only 258. Nor have U.S. installations exploited opportunities to introduce new products. For every new part introduced into a U.S. system, 22 parts were introduced in Japan. In the critical metal-working industries, from which these numbers

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Exhibit I Comparison of FMSs studied in the United States and Japan

	United States	Japan
System development time years	2.5 to 3	1.25 to 1.75
Number of machines per system	7	6
Types of parts produced per system	10	93
Annual volume per part	1,727	258
Number of parts produced per day	88	120
Number of new parts introduced per year	1	22
Number of systems with untended operations	0	18
Utilization rate* two shifts	52 %	84 %
Average metal-cutting time per day hours	8.3	20.2

*Ratio of actual metal-cutting time to time available for metal cutting.

come, the United States is not using manufacturing technology effectively. Japan is.

I have spent several years examining the experiences of companies that have installed FMSs. (See the insert entitled "Primary Research" for details of the study.) The object has been to observe the most sophisticated form of information-intensive technology in manufacturing. Flexible systems resemble miniature factories in operation. They are natural laboratories in which to study computer-integrated manufacturing, which is rapidly becoming the battleground for manufacturing supremacy around the globe.

The battle is on, and the United States is losing badly. It may even lose the war if it doesn't soon figure out how better to use the new technology of automation for competitive advantage. This does not mean investing in more equipment; in today's manufacturing environment, it is how the equipment is used that is important. Success comes from achieving continuous process improvement through organizational learning and experimentation.

Technology leadership

The FMS installations surveyed in *Exhibit I* were, as noted, technically alike. They had similar machines and did similar types of work. The difference in results was mainly due to the extent of the installed base of machinery, the work force's technical literacy, and management's competence. In each of these areas, Japan was far ahead of the United States.

In the last five years, Japan has outspent the United States two to one in automation. During that time, 55% of the machine tools introduced in Japan were computer numerically controlled (CNC) machines, key parts of FMSs. In the United States, the figure was only 18%. Of all these machines installed worldwide since 1975, more than 40% are in Japan. What's more, over two-thirds of the CNC machines in Japan went to small and medium-sized companies.

Just counting how much of this technology companies use is not enough. Because software development lies at the heart of this increasingly information-intensive manufacturing process, the technological literacy of a company's workers is critical. In the Japanese companies I studied, more than 40% of the work force was made up of college-educated engineers, and all had been trained in the use of CNC machines. In the U.S. companies studied, only 8% of the workers were engineers, and less than 25% had been trained on CNC machines. Training to upgrade skills was 3 times longer in Japan than in the United States. Compared with U.S. plants, Japanese factories had an average of 2½ times as many CNC machines, 4 times as many engineers, and 4 times as many people trained to use the machines.

Management's role

A skilled work force and a large installed base of equipment build the foundation for technological leadership. It is the competence of managers, however, that makes such leadership happen. To understand why, we should look more closely at recent experience with FMS technology.

A flexible manufacturing system is a computer-controlled grouping of semi-independent work stations linked by automated material-handling systems. The purpose of an FMS is to manufacture efficiently several kinds of parts at low to medium volumes. All activities in the system – metal cutting, monitoring tool wear, moving parts from one machine to another, setup, inspection, tool adjustment, material handling, scheduling, and dispatching – are under pre-

Primary research

The research on which this article is based took three years and included the detailed study of 95 flexible manufacturing systems in the United States and Japan – more than half the installed FMSs at the time. I examined published and company records of all these installations, held long interviews with managers and system designers, and observed the systems in operation. I had two goals: first, to obtain an overview of the use of the systems, their capabilities, and where they succeed and fail; and second, to understand why and how the successful ones work.

My choice of sites for the second part of this study reflected stringent conditions: all had to be in the same industry, the companies had to have a history of success with two or more systems, and the systems had to influence more than one FMS cell.

Only the machine tool industry in Japan met all these conditions. My choice was especially fortunate in that it is the mother industry for creating capital goods. Machine tool producers use their own products, and their process innovations quickly lead to product development in other areas. Further, the industry is fragmented; most companies are small and family owned. Because the U.S. metal-working industry is structurally similar to the machine tool industry in Japan (more than three-quarters of manufacturing output in the United States comes from operations with fewer than 50 people), my findings bear directly on how these technologies would affect most U.S. manufacturers.

Between 1972 and 1984, 23 companies in Japan built flexible manufacturing systems. Of these, 6 were nonmachine tool companies that wanted them for in-house use. The remaining 17 were machine tool companies; 16 built systems for their own use, 9 built systems for other companies, and 8 sold more than 2 systems. I visited 7 of these companies, including the only 3 that had fully automated factories, and examined in detail the operations of 22 systems.

cise computer control. In operation, an FMS is a miniature automated factory.

The system at one prominent Midwestern heavy-equipment producer consisted of 12 machines that made just 8 different parts for a total volume of 5,000 units a year. Once the FMS went on line, management prevented workers from making process improvements by encouraging them not to make any changes. "If it ain't broke, don't fix it" became the watchword.

The FMS boosted machine uptime and productivity, but it did not come close to realizing its full – and distinctive – strategic promise. The technology was applied in a way that ignored its huge potential for flexibility and for generating organizational learning.

Management treated the FMS as if it were just another set of machines for high-volume, standardized production – which is precisely what it is not. Captive to old-fashioned Taylorism and its principles of scientific management, these executives separated the establishment of procedures from their execution, replaced skilled blue-collar machinists with trained operators, and emphasized machine uptime and productivity. In short, they mastered narrow-purpose production on expensive FMS technology designed for high-powered, flexible usage.

This is no way to run a railroad. Certainly, Frederick W. Taylor's work still applies – but not to this environment. Managing an FMS as if it were the old Ford plant at River Rouge is worse than wrong; it is paralyzing. In this case there was little, if any, attention given to process or program flexibility and almost no support for software improvement. Management failed to utilize the FMS's improved capabilities, from which even greater improvements might have flowed over time.

Not surprisingly, the flexibility achieved by this FMS was much less than that of a stand-alone CNC machining center. And that's the *good* news. The system had four operators per shift, each of whom was responsible for checking gauges, changing hydraulic fluid and parts like drill bits, and making simple diagnoses when something went wrong. These tasks, as specified by management, were very procedural, and no operator had the discretion to change procedures. If anything, the complexity of the FMS forced operators to stick more rigidly to procedure than they did at the stand-alone CNC machining centers.

Goals for management

How, then, should managers look at FMSs? About what should they ask? For one thing, development time. The systems in the United States take 2$^1/_2$ to 3 years and about 25,000 man-hours to conceive, develop, install, and get running. Japanese systems take 1$^1/_4$ to 1$^3/_4$ years and 6,000 man-hours. Here, again, the difference is management. U.S. project teams are usually large groups made up of specialists who design systems for a much greater level of flexibility than their companies are prepared to use. This greater complexity means that projects not only take longer but have plenty of bugs when finished. Delays create enormous pressure on software engineers to take shortcuts and seek hard-wired fixes.

At the end of a project, as a rule, the team is disbanded. The engineers assigned to maintain a system, who are usually not its developers, are reluctant to make any changes. They know about all the bugs but are unwilling to tinker with things because

Exhibit II **Comparison of Japanese FMSs with the systems they replaced**

	FMSs	Conventional systems
Number of parts produced per system*	182	182
Number of systems with untended operations	18	0
Number of machine tools	133	253
Number of operators three shifts	129	601
Utilization rate two shifts	84 %†	61 %

*To make the comparison useful, I have held the number of parts made by each system constant.

†For three shifts, the figure is 92%.

"you never know what may happen." The result: inflexibility.

By contrast, the FMS installations in Japan are remarkably flexible. This would not be so troublesome for the United States if the old-fashioned productivity of its systems, for which flexibility gets sacrificed, were better than that of Japanese systems. But it is not. The average utilization rate (metal-cutting time as a percentage of total time) of U.S. flexible manufacturing systems over two shifts was 52%, as opposed to 84% in Japan. Over three shifts, because of reliable untended operations, the figure in Japan was even higher.

Where does so huge a difference come from? In a word, the *reliability* designed into the system. In Japan, system designers strive to create operations that can run untended. Of the 60 FMSs I studied, 18 ran untended during the night shift. Such systems take more time and resources to develop than those that require even a single attendant, because designers have to anticipate all possible contingencies. But the additional costs are well worth it. So demanding a design objective leads in practice to a great deal of advance problem solving and process improvement. The entire project team remains with the system long after installation, continually making changes. Learning occurs throughout – and learning gets translated into ongoing process mastery and productivity enhancement. This learning is what gives rise to, and sustains, competitive advantage.

Most of the systems built in Japan after 1982 have achieved untended operations and system uptime of an astonishing 90% to 99%. Operators on the shop floor make continual programming changes and are responsible for writing new programs for both parts and systems as a whole. They are highly skilled engineers with multifunctional responsibilities. Like the designers, they work best in small teams. Most important, managers see FMS technology for what it is – flexible – and create operating objectives and protocols that capitalize on this special capability. Not bound by outdated mass-production assumptions, they view the challenge of flexible manufacturing as automating a job shop, not simply making a transfer line flexible. The difference in results is enormous, but the the vision that leads to it is in human scale. No magic here – just an intelligent process of thinking through what new technology means for how work should be organized.

FMS on line

To find out more about this "job shop" approach, I examined more closely 22 FMS installations at Hitachi-Seiki, Yamazaki Mazak, Okuma, Murata, Mori-Seiki, Makino, and Fanuc. As *Exhibit II* shows, these systems far outperformed the conventional CNC equipment they replaced.

Both systems produced the same variety of parts. But the FMSs did it with five times fewer workers than the conventional systems. Moreover, it took only half as many flexible machines to produce the same volume of parts as conventional machines. The CNC machines used in both systems were identical; the FMSs, however, also employed robots, special material-handling equipment, automated storage systems, and tool-handling equipment. These support devices added another 30% to hardware costs, but they helped boost average uptime from 61% to 92% and made untended operations possible. These benefits alone more than justified the extra cost; better quality and reduced inventories were a bonus.

Potential FMS users often worry that the systems are difficult to justify strictly in economic terms. Based on the experiences of Japanese companies, these fears are groundless. All 22 systems I studied in Japan met their companies' ROI criterion of a three-year payback.

Even so, the impact of flexible manufacturing on the performance of a company reaches far beyond simple productivity rates and investment calculations. FMSs take on strategic importance when the installed base of flexible systems in a factory reaches a critical mass. Only when separate "islands of automation" in a plant start to link does management realize the possibilities for new kinds of competitive advantage via manufacturing.

Of the six Japanese companies that used flexible automation extensively, three had fully automated fabrication plants. At the time I visited them, they were the only flexible manufacturing factories in the world. Their productivity was stupendous.

Exhibit III compares the performance of one such factory before and after the introduction of total flexible automation, and *Exhibit IV* shows the effect of such performance on cost structure and competition in an industry. Specifically, the exhibit compares the manpower requirements of various manufacturing systems for metal-cutting operations: if it took 100 people in a conventional Japanese factory to make a certain number of machine parts, it would take 194 people in a conventional U.S. factory – but only 43 in a Japanese FMS-equipped factory. If U.S. companies mastered flexible automation as the Japanese have, they would have more than a fourfold increase in labor productivity. This efficiency in labor is part of the reason that smaller companies in Japan have been able to use FMS technology so effectively.

Perhaps even more interesting than such aggregate improvements are their components. The largest manpower reduction in the exhibit is in manufacturing overhead, where an FMS cuts the number of workers from 64 to 5. In engineering, an FMS cuts the number of workers from 34 to 16. One consequence of these reductions (92% in manufacturing overhead, but only 53% in engineering) is to change the composition of the work force: engineers now outnumber production workers three to one. This may not sound like much at first, but it signals a fundamental change in the environment of manufacturing.

Flexible automation shifts the arena of competition from manufacturing to engineering, from running the plant to planning it. In the FMS environment, engineering innovation and engineering productivity hold the keys to success. Engineering now performs the critical line function. Manufacturing has become, by comparison, a staff or support function.

Managing above the line

Picture a "lights out" factory operating untended, with general-purpose CNC machines that make a wide variety of parts and are capable of adapting easily to new demands. If two such factories compete with similar products, competition will focus on price. This is so because all costs in the development of tools, fixtures, and programs are sunk before the first unit is produced. The only variable costs are those of materials and energy, which usually amount to less than 10% of total costs.

Exhibit III **Performance of one factory before and after automation**

		Before	After
	Types of parts produced per month*	543	543
	Number of pieces produced per month*	11,120	11,120
	Floor space required	16,500 m²	6,600 m²
Equipment per system	CNC machine tools	68	38
	General-purpose machine tools	22	5
	Total	90	43
Personnel per system: three shifts	Operators	170	36
	Distribution and production control workers	25	3
	Total	195	39
Average processing time per part†: days	Machining time	35	3
	Unit assembly	14	7
	Final assembly	42	20
	Total	91	30

*To make the comparison useful, I have held these figures constant.

†This includes time spent in queue.

Exhibit IV **Manpower requirements for metal-cutting operations to make the same number of identical parts**

	Conventional systems		FMSs
	United States	Japan	Japan
Engineering	34	16	16
Manufacturing overhead	64	22	5
Fabrication	52	30	4
Assembly	44	32	18
Total number of workers	194	100	43

Note:
There is no column here for FMSs in the United States because, at the time of this study, no domestic machine tool producer had an FMS on line.

Exhibit V Degree of automation in production activities of 20 Japanese FMSs in numbers of systems

	Metal-cutting operations	Material handling		Setup		Process control*	Production control		Inventory management	
		Parts	Tools	Parts	Tools		Planning	Dispatching	Parts	Tools
Manual	–	–	–	16	13	–	4	–	–	–
Manual with computer assistance	–	–	–	2	–	–	6	–	–	–
Automated with manual override	2	–	–	–	2	–	10	–	–	15
Untended†	18	20	20	2	5	20	1	20	20	5

*Tool monitoring, inspection, and feedback.

†To qualify as untended, a system had to run without manual assistance for one shift a day and have a 90% utilization rate.

Exhibit VI Production activities in an average FMS in Japan*

	Metal-cutting operations	Material handling		Setup		Process control	Production control		Inventory management		Total
		Parts	Tools	Parts	Tools		Planning	Dispatching	Parts	Tools	
Average system losses as a percentage of total time	1.6%	5%	–	–	5%	2%	–	3%	–	–	16.6%†
Manual labor time per system hours	2	–	–	11	7	3	2.5	.5	–	–	26

*An average FMS in Japan has six machines, creating a total of 144 hours of available metal-cutting time per day.

†This figure seems to imply that the system's utilization rate over three shifts would be 83.4%, not 92% as asserted in *Exhibit II*. There is no discrepancy; the figures don't match because problems in some areas, such as material handling, cause system losses that do not result in machine downtime.

Each factory's profits will erode over time as other companies acquire the same operating capabilities. How, then, would a company stay ahead? One way is by creating new physical assets in the form of better programmed and better managed equipment. Each plant's competitive fate would rest heavily on its ability to create facilities that generate performance advantages – and to do it faster than the competition. When the lion's share of costs are sunk before production starts, the creation and management of intellectual assets becomes the prime task of management.

This is manufacturing's new competitive environment. It may sound like something from the distant future, but the Japanese are doing it now. The crucial variable in this kind of environment is automation – the ability of an FMS to run untended. And Japanese manufacturing companies are becoming increasingly expert in that field.

Exhibit V summarizes my findings from 20 of the 22 Japanese FMSs on the extraordinary degree of automation reflected in different production activities. *Exhibit VI* presents data from these 20 systems on the amount of manual labor time spent on the factory floor to support such levels of automation. Average system losses took 16.6% of total operating time, about a third the figure in U.S. systems. Each 144 hours of metal-cutting time took only 26 hours of manual effort, which included direct labor as well as required activities usually associated with manufacturing overhead. In the United States, manufacturing overhead activities are separated from direct labor and take about ten times longer.

In most plants, 26 hours of manual effort translate into two workers per system for each of two shifts. In all 22 of these FMSs, however, there was a third person on each shift, whose work accounted for part of the 26 hours of manual effort. By dividing the work among three people, the companies that had these systems purposely created extra time for such process-improvement activities as additional test cutting of new parts, observing machine behavior, and examining statistics on performance. In all 22 systems, each of the workers did these nonrequired – but immensely valuable – tasks. The number of people required to do all this in conventional systems making the same parts in the same companies was four times greater.

The distribution of the 26 hours of manual effort is also instructive. More than half were spent loading and unloading pallets. The other major activity, which took 7 hours, was mounting tools and qualifying them on machines. Together, these efforts accounted for 80% of the time spent on manual labor. Workers loaded pallets and mounted tools during the day shift, and the machines ran untended at night. Production planning, a weekly activity, took only one hour of a person's time. Systems making a large variety of parts also had automated methods for production planning. Those with a low variety of parts did it manually.

The FMS installations performed exceptionally well. Delivery performance in each system, tracked during a three-month period, was 100%. The high reliability of individual machines and of the system itself kept the variance in unscheduled downtime to only 2%. The scheduled slack for software testing and process experiments ranged from 4% to 9% of capacity and was more than enough to accommodate any variation in machine reliability. Each system met its production schedule, as long as the schedule observed the constraints of capacity. In addition, only six pieces in a thousand had a quality problem. Of these, three were reworked, usually by the operators themselves. The other three were scrapped. Tool breakage caused most of these quality problems, and the machine operators could make the necessary adjustments.

With such impressive levels of performance, few contingencies demanded management's attention. In fact, executives were largely absent from day-to-day operations. Instead of concerning themselves with internal operations, they focused their attention on how to meet competitive pressures on product performance. In the United States, on the other hand, managers spend so much time on routine problems with quality and production delivery schedules that they have virtually no time left over to plan for long-term process improvement.

As noted before, the prime task of management once the system has been made reliable is not to categorize tasks or regiment workers but to create the fixed assets – the systems and software – needed to make products. This calls for intellectual assets, not just pieces of hardware. Thus the new role of management in manufacturing is to create and nurture the project teams whose intellectual capabilities produce competitive advantage. What gets managed is intellectual capital, not equipment.

The technology of flexible manufacturing has led managers into a drastically altered competitive landscape. This new landscape has a number of important features:

> A sharp focus on intellectual assets as the basis for a company's distinctive competence.
>
> A heightened emphasis on the selection of the portfolio of projects a company chooses to manage.
>
> A close attention to the market and to the special competence of process engineers.
>
> A steady adjustment of product mix and price in order to maintain full capacity utilization.
>
> A pointed emphasis on reducing fixed manufacturing costs and the time required to generate new products, processes, and programs.
>
> An intensification of cost-based competition for manufactured products.

I am convinced that the heart of this new manufacturing landscape is the management of manufacturing projects: selecting them, creating teams to work on them, and managing workers' intellectual development. In company after company in Japan, systems engineers with a thorough knowledge of several disciplines have proved the key to the success of flexible manufacturing systems. One rigidly organized Japanese company, recognizing the importance of such versatile teams, now rotates experienced engineers through all manufacturing departments. Another, which already had job rotation, has begun to keep its engineers longer in each area so they can learn more from their FMS experience.

In contrast with the traditional Japanese approach of involving a large number of people in decision making, small teams of highly competent, engineering-oriented people have been most successful with flexible manufacturing. These groups have succeeded because they are given responsibility for both design and operations. They remain on a project until the FMS achieves 90% uptime and untended operations. Perhaps most important, in all the Japanese companies I studied, the teams came entirely from engineering and were given line responsibility for day-to-day operations.

New mission statement

The management of FMS technology is taking place in a different manufacturing environment, and thus consists of new imperatives:

Build small, cohesive teams. Very small groups of highly skilled generalists show a remarkable propensity to succeed.

Manage process improvement, not just output. FMS technology fundamentally alters the economics of production by drastically reducing variable labor costs. When these costs are low, little can be gained by reducing them further. The challenge is to develop and manage physical and intellectual assets, not the production of goods. Choosing projects that develop intellectual and physical assets is more important than monitoring the costs of day-to-day operations. Old-fashioned, sweat-of-the-brow manufacturing effort is now less important than system design and team organization.

Broaden the role of engineering management to include manufacturing. The use of small, technologically proficient teams to design, run, and improve FMS operations signals a shift in focus from managing people to managing knowledge, from controlling variable costs to managing fixed costs, and from production planning to project selection. This shift gives engineering the line responsibilities that have long been the province of manufacturing.

Treat manufacturing as a service. In an untended FMS environment, all of the tools and software programs required to make a part have to be created before the first unit is produced. While the same is true of typical parts and assembly operations, the difference in an FMS is that there are no allowances for in-the-line, people-intensive adjustments. As a result, competitive success increasingly depends on management's ability to anticipate and respond quickly to changing market needs. With FMS technology, even a small, specialized operation can accommodate shifts in demand. Manufacturing now responds much like a professional service industry, customizing its offerings to the preferences of special market segments.

Making flexibility and responsiveness the mission of manufacturing flies in the face of Taylor's view of the world, which for 75 years has shaped thinking about manufacturing. FMS technology points inevitably toward a new managerial ethos – an ethos dedicated to the building of knowledge in the flexible service of markets, not merely to the building of things. Scale is no longer the central concern. Size no longer provides barriers to entry. The minimum efficient scale for FMS operations is a cell of roughly six machines and fewer than a half a dozen people. That's the new reality.

Going to FMS-based operations does *not* require lots of money or people. It can be done – at its best, it *is* done – on a small scale. The critical ingredient here is nothing other than the competence of a small group of people. There is no Eastern mystery in this, no secrets known only to the Japanese. We can do it too – if we will.

What, after all, is a manufacturing company? Today, no artist would represent a factory as a huge, austere building with bellowing smokestacks. The behemoth is gone. The efficient factory is now an aggregation of small cells of electronically linked and controlled FMSs. New technology enables these operating cells to be combined in nonlinear ways. No shared base of infrastructure mandates large-scale production integration. The days of Taylor's immense, linear production systems are largely gone.

Unless U.S. managers understand the implications of Japan's mastery of FMS technology, their companies will fall further behind. Flexible manufacturing systems are no longer a theory, a pipe dream. They exist. And the leverage they provide on continuous process improvement is immense. Making automation work means a whole new level of process mastery. A large number of Japanese factories demonstrate its reality every day. They lead the way; we linger behind at our own peril. ⛉

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Senator **Levin**. Thank you, Doctor, very much. I wonder if you both would focus on a question of specific Government policies.

If you were a Member of the Congress, or if you were the Congress, and you could wave the wand and adopt a new Government policy, which policy would you put at the top of that list, second on the list, and so forth?

Give us a priority list of specifics as to how we can encourage or remove impediments to small business, adopting the new technologies which will permit them to compete. Dr. Kegg, do you want to go first?

Dr. **Kegg**. The first and most direct thing that can have the most immediate impact is a financial incentive.

Something like the tax incentive for capital investment aimed at new technology, and perhaps focused on the small business that you hope to help. In my view, this is probably the only kind of thing that can make a direct and immediate measurable impact.

In the longrun, there are programs already underway in existing institutions to support the development of technology, to support the development of research and knowledge and information, and a flow of smart, bright trained young engineers into the workforce, into the manufacturing environment.

These programs need to be better funded. At the present time, every legislative unit in the country, down to village councils, is eager to create jobs in their community. And they all want to have a research institution at each crossroads in the United States. And lots of money is being spent on it.

And it is being distributed $1,000 a pop. And it is so diffused that we will not create world-class research institutions. What we need is monies and funds to create as many world-class engineering manufacturing technology research institutions as we can afford, such as is being done at the Bureau of Standards at the present time.

In my view, we have only one in the United States, as opposed to many in Western Germany, and several in the United Kingdom. And these things in the longrun can provide the bright young minds and the entrepreneurship to feed small industry to start venture companies to address the solution to manufacturing problems.

Senator **Levin**. Are those institutions in Germany and the United Kingdom totally public? Or are they public-private? What are they?

Dr. **Kegg**. In each country, and in each country it is done differently, in West Germany these are joint research organizations.

In particular, the Fraunhoffer Institutes, which are partially Government-supported, partially industry-supported, closely associated with the leading universities, separate clearly from the universities. And so that it is possible to develop a close cooperation with industry and not disrupt the university.

In Japan, it is done differently. In the United Kingdom, it is done differently. In each culture it must be done differently. Just because it is what will play in that culture.

Senator **Levin**. The closest thing we have here to that, you say, is the Bureau of Standards operation?

Dr. KEGG. In my view, the AMRF at the Bureau of Standards is the only world-class manufacturing research in the United States.

Senator LEVIN. Dr. Jaikumar.

Dr. JAIKUMAR. I would disagree with Dr. Kegg on that. I think the approach of providing incentives, while in the short is viable for a while, eventually we need to set up structures to make these products cheap.

It should make financial sense on its own. If the technology is as good as it is promised to be, why should it not make financial sense?

What we should do is foster the kind of research that creates standard products, cheap products, that brings this technology down and makes it easily accessible.

Senator LEVIN. You say foster the kind of research. Are you talking about a Government——

Dr. JAIKUMAR. I am talking about Government. It has not taken place——

Senator LEVIN. You are talking about research in the private sector?

Dr. JAIKUMAR. No. I am talking about the Government, like the National Bureau of Standards.

Senator LEVIN. Then how do you disagree with Dr. Kegg?

Dr. JAIKUMAR. In the sense that the priority one he had mentioned was financial incentives, and I thought he said the second one was the priority on standardization.

Senator LEVIN. So you would just re-order his priorities?

Dr. JAIKUMAR. I would not put the financial incentives as the number one priority.

Senator LEVIN. What Dr. Kegg was referring to, as I understand, was tax incentives specifically. Like an investment tax credit. So you would not put that at the top of your list?

Dr. JAIKUMAR. I would not.

Senator LEVIN. You would put his second priority at the top of your list?

Dr. JAIKUMAR. I would put the second.

Senator LEVIN. And what would you put as your second priority?

Dr. JAIKUMAR. The second priority is much wider training and education to create the skills required that small businesses can access.

We do create these skills. But they do not go to the small businesses. It goes to the larger companies. It is not widespread enough. And I think we need to find mechanisms where training and education with newer technologies would be more widespread.

Senator LEVIN. Do you think Government should be involved in that, relative to small businesses? And if so, how?

Dr. JAIKUMAR. The Government could provide, either through vocational training institutes, more training in secondary and primary education to generate some of the skills, like flexible manufacturing cooperatives which are just starting.

I would recommend more of those so that it could reach and be more accessible to small business. That has not taken place. That would be number two for me.

Senator **Levin**. Dr. Kegg, on the tax credit issue, last year we eliminated the investment tax credit in the so-called tax reform bill.

As I remember, there was not a lot of opposition to that bill or to that particular part of it from the manufacturing world. I was particularly sensitive to that, because I came from a State which I thought would be negatively impacted by the elimination of that tax credit.

And I did not see a lot of organized opposition to that bill from the portion of the business world which you think would be particularly tuned in to the problem of eliminating that credit. How do you explain that?

Dr. **Kegg**. In the last 30 years, there has not been a close relationship between industry in the United States and Government.

It has been an adversarial relationship. And industry has not done a good job of working with Government bodies. We still do not do a good job, in my opinion. We have failed.

If your impression is that there was not a lot of opposition, then industry failed, because industry certainly opposed it. But we did not organize ourselves well, because we are not accustomed to working with Government. We are accustomed to an adversarial relationship.

Senator **Levin**. Well, I think the groups representing industries in general favored the tax reform bill.

You say industry opposed it. Were you referring to the investment tax credit?

Dr. **Kegg**. The elimination of the investment tax credit in particular.

Senator **Levin**. Well, the bill which contained that provision was, I believe, supported by almost all umbrella groups of major manufacturing, small business groups, and so forth.

Does that not then mean that the investment, the elimination of that tax credit, was not a major concern to small businesses, the manufacturing businesses?

If it was not enough to cause them to oppose the entire tax reform bill, does that not say that it was not that important to them?

That came as a surprise to me. So I am asking you that as somebody who was surprised by it. I am not arguing with your conclusion at all.

Dr. **Kegg**. I am as surprised as you are by the impression that you have, because my acquaintances in industry believe very strongly in the investment tax credit as a means of encouraging U.S. industry to be competitive.

Senator **Levin**. The report that we received from the Congressional Research Service, that I made reference to before, talks about a Japan robot lease company.

One of the references is to a company which was established, and I am quoting, by Japanese equipment manufacturers in 1980 and funded with $12 million annually by the Ministry of International Trade and Industry. So you actually in Japan have a governmental entity which is funding a leasing operation.

And again quoting, it, says this leasing company is responsible for placing automated machinery and computer numerically controlled machine tools to be placed among small Japanese tool and die producers.

Is that culturally possible? Is it wise? Does it work in Japan? It violates the direction we are moving, which is to basically get Government out of things rather than Government into things.

Can you give me a rationale? Why don't we start with you, Dr. Jaikumar?

Dr. **Jaikumar**. I think it will work. It has worked in Japan.

It has worked over here in the Agricultural Extension Service earlier on, when the Government did have a role in bringing the latest technology forward in agriculture, where the industry is small-scale and Government did have a role.

And if you look at the number, $12 million is not a lot of money. It is not the leasing, it is not the financial aspect of it which drove that objective. It was the education and the training.

It is the familiarity with what these robots could do and getting that to business which affected that change in the 1980s in the Japanese robot leasing company, for instance.

And all through the mid-1980s, when the major machine tool vendors in Japan started pushing small standardized CNC machines to small-scale businesses, it was always with an educational component, and associated with that. And I think that is what that model is.

And when I talked about cooperators and getting this technology down to these people with flexible manufacturing, it was with that in mind that we have to bring, that kind of a model could very effectively work.

Dr. **Kegg**. May I comment on that?

Senator **Levin**. Sure. Please, Dr. Kegg.

Dr. **Kegg**. We believe that MITI, the Ministry of International Trade and Industry in Japan, is very, very much involved in encouraging and supporting and working for the prosperity of Japanese industry in many ways which would be totally unacceptable to the American voter, ways which are very effective for Japanese, but which would be unacceptable in this country.

Senator **Levin**. Unacceptable because of our mindset and our culture?

Dr. **Kegg**. It is our mindset and our culture.

Senator **Levin**. How about your mindset? Would it be unacceptable to you?

Dr. **Kegg**. I am an American. I feel the same way, that selecting companies and giving them markets and not having competition is not the right way to do things. However, the Japanese, MITI, have done some things which would be acceptable in our culture.

Such as, to my personal knowledge, the famous Sukuba automated factory project, which was funded by MITI, and which mustered together the best brains of the Japanese research community and the best experienced people of Japanese industry together to make a dramatic demonstration project.

The results of this project were that it was built and it was dismantled. And from across the ocean we sometimes snicker and look at it as impractical. But in fact one very specific result of this factory, it is a different way of working and a different way of thinking.

To make this factory, Government representatives, industry representatives, and university research representatives worked together to see how they could, to each of their mutual benefit, use the funding of this demonstration project.

As a result, very little of the money was spent on the salaries of the researchers. Most of it was subcontracted to industry.

And a very specific benefit of this was that a 20 KW laser power supply, a very high-power industrial laser power supply, was subcontracted to the Mitsubishi Corp., which was not a suffering or needy corporation.

In fact, it was subcontracted to them because they were a thriving corporation. This put them in the 20 KW laser business. Although the project went nowhere, their industry was put in the laser power supply business as a result of it.

The researchers accomplished their aim, the Government accomplished their aim of a demonstration project, and industry prospered as a result of it. This kind of thing would be acceptable in the United States.

Senator **LEVIN**. Where was the project supposed to go that it did not go?

Dr. **KEGG**. There was never any intention that it be anything more than a project to the mutual benefit of industry, Government, and research for the doing of the project.

Senator **LEVIN**. I am going to have to run over to vote now. And so what we will do is take a break here at the end of this panel.

We appreciate your being here. Your entire statements will be a made part of the record.

We will start with the second panel as soon as I can get back, which will be about 5 or 10 minutes, or one of my colleagues arrives. Again, our thanks to both of you.

[Recess.]

Senator **LEVIN**. We will come back to order. We will move to our second panel now, which is a panel that is made up of two friends. Eric Mittelstadt, who is the president of GMF Robotics in Troy, MI.

GMF is the largest manufacturer of robotics in the country, I believe. And if they are not, since you are from Michigan, you are anyway. [Laughter.]

And Jim Koontz, who we have made reference to before. President and CEO of Kingsbury Machine Tool Corporation of Keene, NH.

Jim, welcome to you. And why do you not start with a brief summary? And we will go alphabetically this time. I do not know what we did last time. Unless there is some other order I should know about, why do you not start off with a summary of your statement?

STATEMENT OF JAMES L. KOONTZ, PRESIDENT AND CEO, KINGSBURY MACHINE TOOL CORP., KEENE, NH, ACCOMPANIED BY JAMES MACK, PUBLIC AFFAIRS DIRECTOR, NATIONAL MACHINE TOOL BUILDERS ASSOCIATION

Mr. **KOONTZ**. Thank you, Mr. Chairman, and good morning. My name is James Koontz. I am president and chief executive officer of Kinsbury Machine Tool Corp., Keene, NH.

My company is one of over 300 machine toolbuilding firms represented by the National Machine Tool Builders Association. Accompanying me this morning is James Mack, NMTBA's public affairs director.

On behalf of Kingsbury Machine Tool Corp. and NMTBA, I would like to express appreciation for this Subcommittee's interest in the key role our industry plays in the development of a competitive and efficient automative manufacturing base.

Over 80 percent of the machine toolbuilders in America are considered small businesses. Although the industry is relatively small by some corporate standards, America's machine toolbuilders account for a very basic and strategic segment of our Nation's industrial capacity.

Our industry builds the machines essential to our military readiness, and our ability to respond quickly and effectively in the event of a national emergency. Our product is the very essence of the industrial manufacturing process. We produce the tools of production. We consider our industry a strategic national resource.

Today the industry is generally undercapitalized. And imports account for 49 percent of the United States machine tool consumption. Recent studies find that compared to the Japanese, United States capital costs are almost twice as high.

As a result, our Japanese competitors have been able to invest more heavily in the new technologies and thus improve their productivity and the cost-competitiveness of their product.

Last year Congress increased the cost of capital for all industries, small and large. Taxes on investments and new manufacturing technology were increased by about 50 percent. The net effect of dropping ITC and revised depreciation schedule.

And, Mr. Chairman, on the issue that you asked Mr. Kegg before of whether we testified against tax reform and the dropping of ITC, I personally testified in the House Ways and Means Committee that it not happen.

But I was told by the time it got to the Finance Committee of the Senate that it was a very necessary thing in order for us to have a tax bill at all. And therefore by the time it got to that point, we had backed off and accepted it. With the comment that we would probably be back within the year, because it would have a tremendous effect on the investment in this country.

Senator LEVIN. Negative effect?

Mr. KOONTZ. A negative effect, which it has. I will follow on with my comments of what happened.

Today's taxes on capital investments are approximately the same as they were in 1981, when every knowledgable economist recognized they were an impediment to United States productivity and competitiveness.

Together with the product liability, which is another major problem in the industry today, the U.S. tax system creates a domestic environment which inhibits a favorable market here and abroad for many small businesses.

One example of the tax system working against small business is the corporate alternative minimum tax. The stated purpose of the AMT is to require profitable corporations to pay their share of taxes.

However, the AMT has an adverse effect on corporations that are both marginally profitable and capital-intensive. That certainly describes small businesses and particularly machine tool industries of today.

The budget reconciliation bill adopted by the House raises the AMT base, thus substantially increasing the AMT. The Senate Finance Committee has declined to do so. And we urge you to hold firm and vote no on any increase in the AMT when the reconciliation bill reaches the Senate Floor in the next few days.

The U.S. manufacturing sector has been systematically neglected since World War II. We did build the greatest industrial capacity the world has ever known. And liked it so much we left it alone for the last 30 years.

Of course, management takes some credit for this. The new in-management style of the 1960s claimed they did not need manufacturing know-how. And since 1960, most U.S. corporations have focused on producing products. Not on investing in manufacturing processes.

The results are history. As you know, the Japanese cleaned our clock. Not with product development. But with manufacturing process know-how. Manufacturing process capability is America's Achilles heel.

What can we do about it? Capital recovery through tax changes is one solution. But there are other and more deeply-rooted problems.

We need to reform our product liability laws, because the current hodge-podge of confusing and sometimes unfair state laws are created in a climate in which American industry is spending more money on lawyers to defend ourselves than we are spending to acquire new machine tools to improve our productivity.

We need to reform our export control laws, which destroy our ability to compete in overseas markets. This country also needs to re-examine its entire educational system.

We do not have ample training programs for our young people to learn and establish the critical skills that are and will continue to be necessary in our rapidly changing world technology.

We no longer have the many good vocational training facilities, where young people with mechanical aptitudes can become skilled in many trades. The public vocational schools are almost nonexistent, as are many of the industry's former fine apprenticeship programs.

I myself was a product of a General Motors apprentice program. The GM Program was stopped in 1956. It is imperative that programs be funded to ensure that these future skilled people will be available to serve the needs of our country and our industry.

It is also important that our young people be given opportunities to utilize these talents. One such effort has begun in Detroit, with the establishment of the center for advanced technology.

And Mr. Chairman, I know you know Father Cunningham. But if any others of you do not, you will soon learn to know Father Cunningham.

The Center for Advanced Technologies primary task will be to train technologies we need to support a strong manufacturing base. The program will serve as a role model for much needed programs in many other areas of the United States.

Turning to higher education, foreign competition know before any of us what new developments are forthcoming from our universities' labs. Why? One reason, that over 60 percent of the students in the labs of our universities are foreign nationals. This has to change.

We need to find ways to encourage more of our young people to pursue a career in engineering, and preferably manufacturing engineering and research.

President Reagan's Commission on Industrial Competitiveness summed up the problem well when it reported, we need to create, apply, and protect new technology. It is precisely this aspect of our problem that needs to be addressed by both the private and the public sector.

Speaking as the current chairman of the National Center for Manufacturing Sciences, we have a beginning of a private sector-driven consortium to address our industrial competitiveness.

The mission of NCMS is straightforward. To aid U.S. industry in regaining of sustaining manufacturing leadership in a global economy.

This is to be accomplished by pooling our resources, both human and financial, establishing national guidelines to promote cooperate research, avoiding duplication, and then tackling of projects too large and too risky for individual companies.

The management and the use of manufacturing technology is a part of the agenda as well. It is this kind of joint research from which we will all benefit.

NCMS currently has 85 members. More than 40 of them will be considered small businesses. We have commitments of $45 million, including a $15 million matching grant from the Federal Government.

And Mr. Chairman, I encourage you and all the Members of this Subcommittee to continue your support of this effort. The manufacturing sector is undergoing fundamental changes.

To survive in today's international competitive climate, both Government and business must realize that business conditions are now radically different from what they have been, and will never return to their earlier status.

The time is right to accelerate our efforts to bring new management disciplines, educational institutions, manufacturing industries, and Government together in the search for historic breakthroughs.

And, I hope my presence here today has provided this Subcommittee with some insight into the status and the needs of the manufacturing sector.

It is evident that more efficient production technologies must be developed and implemented, if the United States is going to compete successfully in expanding global markets.

The continued deterioration of the manufacturing segment of our industrial base will not only reduce our ability to support our military forces, but will also destroy a credible deterrent, and will ultimately lower the standard of living of every American. Action is needed now on a national scale. Thank you, Mr. Chairman.

[The prepared statement of Mr. Koontz follows:]

STATEMENT BY JAMES L. KOONTZ
PRESIDENT AND CHIEF EXECUTIVE OFFICER
KINGSBURY MACHINE TOOL CORPORATION
BEFORE THE
COMMITTEE ON SMALL BUSINESS
SUBCOMMITTEE ON INNOVATION, TECHNOLOGY & PRODUCTIVITY
UNITED STATES SENATE
DECEMBER 2, 1987

I. INTRODUCTION 1

II. STATUS OF THE MACHINE TOOL INDUSTRY 2

III. IMPORTED MACHINE TOOLS 3

IV. EXPORT CONTROLS 10

V. PRODUCT LIABILITY 13

VI. TAX LEGISLATION 15

VII. PUBLIC AND PRIVATE SECTOR PROGRAMS 17

VIII. CONCLUSION 19

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I. INTRODUCTION

Good morning, my name is James Koontz. I am President and Chief Executive Officer of Kingsbury Machine Tool Corporation of Keene, New Hampshire. My company is one of over 300 machine tool building firms represented by the National Machine Tool Builders' Association (NMTBA). Accompanying me is James H. Mack, NMTBA's Public Affairs Director.

On behalf of Kingsbury Machine Tool Corporation and NMTBA, I would like to express appreciation for this Subcommittee's interest in the status of the American machine tool industry and the key role our industry plays in the development of a competitive and efficient automated manufacturing base. Over 80 percent of NMTBA's members are small businesses.

Our members are engaged in the business of manufacturing the tools of metalworking productivity including cutting, grinding and forming machines, universal measuring machines, and automated production systems. Although the industry is relatively small by some corporate standards, America's machine tool builders account for a very basic and strategic segment of the nation's industrial capacity. Our industry builds the machines essential to our military readiness and our ability to respond quickly and effectively in the event of a national emergency. Our product is the very essence of the industrial manufacturing process. We produce the "tools of production." Our industry is the belt that holds up the pants of our defense capabilities. A slip of one notch could be enough to have this country find itself in a compromising situation.

II. STATUS OF THE MACHINE TOOL INDUSTRY

Unfortunately, the machine tool industry continues to operate in a stagnated market. Based on the first three quarters, 1987 will see orders down about 10 percent and shipments down about 15 percent from 1986 figures. The entire U.S. machine tool industry is likely to account for about $2 billion in total new orders for the current year. Last year, measured by value, imported machine tools accounted for 49 percent of U.S. machine tool consumption.

The most vulnerable domestic markets are machining centers, and numerically controlled turning machines and punching machines. These classes of machine tools are the "high tech" defense-sensitive tools which are vital components of flexible manufacturing systems and "factories of the future." Automated machine tools within automated plant models will provide efficient and competitive production facilities for peacetime manufacturing. And perhaps more importantly, the military readiness that America needs to prepare for and to deter global conflict.

In spite of the severe downturn in business, the U.S. machine tool industry's commitment to research and development, measured as a percentage of sales, is among the highest of any industry.

Numerical control, computer control, flexible manufacturing systems, and a host of other advanced machine tool technologies were all invented in the United States, and more of these advanced technology machines have been built by U.S. machine tool builders than by any other nation.

A recent study conducted by the Joint Trade Association Committee on Industrial Automation Market Statistics, of which NMTBA is a member, uncovered some interesting trends. The study illustrates that, in 1980, 15 percent of all automation was purchased by small businesses. By 1995, however, it is predicted that these small companies will account for 34 percent of all automation purchases.

According to the 1983 American Machinist Inventory of Metalworking Equipment, the machine tool industry reflects these trends. American Machinist points out that in 1983, 5 percent of the machine tools on the shop floors of small companies were numerically controlled. A figure comparable to the level of automation in large companies at that time. Of that 5 percent, over half of the NC machines were bought between 1979 and 1983. Obviously, the trend is toward an automated factory of the future. Since that period, we've seen shipments of NC machines as a percentage of total machine tool shipments climb from 29 percent in 1980 to over 60 percent in 1986.

These figures suggest that the demand for automated products will continue to grow at a rapid pace and that small business will contribute substantially to that trend. This will place even greater competitive pressures on our industry, as Japanese and other foreign producers target our domestic market!

During the last two and a half years, Hughes Aircraft Company, L.T.V., Watervliet Arsenal, General Dynamics Corporation, and Lockheed Aircraft Corporation have purchased flexible manufacturing systems costing $12-$14 million each from U.S. machine tool builders. The systems were competed internationally and the U.S. manufacturers were not the lowest bidders. If foreign technology was superior to that of the U.S. machine tool industry, you can be sure the foreign builders (with their lower bids) would have gotten these orders.

The charge has been made that we are an old, inefficient, "smokestack" industry which has not kept pace with other nations in advanced machine tool technology. However, a recent study by The Machine and Tool Blue Book emphatically states -- "in the opinion of America's manufacturing engineers, America's machine tool builders are tops in technology."

The need for automated machine tools has been established. However, the machine tool builder faces many obstacles which impede competitiveness and productivity. I will attempt to address these obstacles in order to enhance this Subcommittee's understanding of the machine tool industry's problems. The impediments our industry faces apply not only to machine tools but to the products of many other small business industries as well.

III. IMPORTED MACHINE TOOLS

The staggering import penetration of the U.S. machine tool market is caused by three factors. First, the overvaluation of the dollar has caused a staggering price penalty for all American products in world markets. The recent decline in the value of the dollar has resulted in higher U.S. machine tool expenses.

Second, because of differences in American tax laws and financial structures, the cost of capital in Japan and other manufacturing countries is much lower than in the United States. The 1985 Report of the President's Commission on International Competitiveness "Global Competition - The New Reality" states -- "American firms face much higher costs for the capital they need to invest. These higher costs are the result of the Federal Government's competition with the private sector for funds, a tax system biased against investment, premiums charged by lenders expecting monetary policy, and the relatively greater reliance by American firms on equity (stock) financing. Recent studies find that, compared to the Japanese, U.S. capital costs have been up to twice as high. As a result, our Japanese competitors have been able to invest more heavily in new technologies and thus improve their productivity and the cost-competitiveness of their products. A study by the Semiconducter Industry Association shows that the Japanese success in semiconductors during the 1970's was due, in large part, to the advantage of low capital costs, not superior technology. In short, a lower cost for capital represents a major competitive advantage to our competitors."

Last year, Congress increased the cost of capital for the machine tool industry and its customer base. Taxes on investment in new machine tools were raised by about 50 percent. Today's taxes on capital investments are approximately the same as they were prior to 1981 -- when every knowledgeable economist recognized that they were an impediment to U.S. productivity and competitiveness.

And third, to make certain that their machine tool industry flourishes, the Japanese and other nations have provided large export subsidies and favorable domestic treatment including:

- lower taxes;
- direct and indirect subsidies;
- relaxed or nonexistent anti-trust enforcement; and
- the rankest kind of protectionism.

The combination of these factors caused imports to increase at such an alarming rate that national security of the United States was threatened. Therefore, NMTBA filed in March, 1983, a petition under Section 232 of our trade laws asking for temporary import relief to protect the national security.

As a result of NMTBA's 232 petition, the Administration recognized -- albeit belatedly -- the danger presented to our national security by dependence upon foreign sources for machine tools. Characterizing the machine tool industry as a "small, yet vital component of the U.S. defense base," the President announced his decision to seek Voluntary Restraint Agreements (VRAs) on machine tool imports. President Reagan directed that import levels of seven classes of machine tools be negotiated with Japan and certain other countries last fall. VRAs were successfully negotiated with Japan and Taiwan. More will be negotiated if other countries significantly expand their machine tool exports to the U.S. so that the purpose of the program is thwarted.

Many on this Subcommittee -- including you, Mr. Chairman -- were extraordinarily helpful in communicating to the Administration your strong support for our petition. Your communications played a major role in the ultimate outcome of our case.

I can speak personally to the immediate positive effect of the VRAs. Kingsbury Machine Tool Corporation is now manufacturing a machining center whose domestic production had fallen under its former owner to zero because of severe import penetration. I am proud to say that Kingsbury has hired over 120 new employees and is producing and selling this machining center as a direct result of the VRAs.

Last year Congress adopted a provision (Sec. 9118) of the FY '87 Omnibus Appropriations Continuing Resolution restricting Department of Defense (DoD) foreign machine tool procurements. This amendment stated that FY '87 funds could not be used by the Defense Department to purchase, for use in DoD facilities, defense-sensitive machine tools from sources other than the U.S. and Canada. There are provisions for exceptions to this policy where they are properly justified. For national security reasons, these restrictions should be continued in the FY '88 DoD Appropriations Bill.

Direct DoD purchases of machine tools as a percentage of domestic machine tool consumption (including imports) has grown during the past several years - partially as a result of increased DoD production needs and partially because overall machine tool demand has shrunk during the same period. Historically, the Department of Defense, as a matter of policy, has procured American-made machine tools for use in DoD facilities. However, using the Department of Defense's own figures, Navy purchases of foreign machine tools, as a percentage of overall machine tool purchases, quadrupled between 1982 and 1985, and purchases by all three services almost doubled. Most of these foreign machines came from NATO countries. Imports from Japan, Taiwan and other countries were subject to the Buy America Act.

If DoD facilities become foreign-source dependent for machine tools, work stoppages and delays due to the unavailability of spare parts, major components, service, etc., would adversely affect the production and repair of critically needed weapon systems. If reliability problems arise with foreign equipment (and some are already occurring in U.S. defense facilities) many U.S. distributors from whom DoD has bought foreign equipment, have no capability to provide parts and service.

In some cases foreign nationals are required to install, repair and service the machine tools they have supplied. There is a risk of compromising the security of U.S. weapons technology by use of foreign machine tools in these classified and sensitive defense facilities.

Other nations, including our NATO allies, recognize the threat that procurement of foreign-made machine tools could pose in their defense establishments. Therefore, they never procure foreign machine tools for their defense facilities if the required tools are available from within their country. During the past six years, our NATO allies enjoyed a $2.3 billion positive trade balance for machine tools. Continuing the restriction on DoD procurements will have very little impact on the overall machine tool trade balance between the U.S. and our NATO allies.

For those reasons, NMTBA strongly urges that the restrictions on DoD foreign machine tool procurements be continued.

The trade bill passed by the Senate last summer will help industries impacted by unfair foreign competition. Under the bill, foreign export targeting has been explicitly identified and defined as an actionable unfair trade practice under Section 301. Domestic victims of targeting, upon a showing that a foreign government is, or has been, engaged in a targeting program, will be assured of a timely response in the form of mandatory action which will eliminate or offset the actual or potential effects of the export targeting on the petitioning industry. Retaliation is but one option. Other means of addressing the problem include the negotiation of orderly marketing agreements with offending governments, as well as administrative action geared toward restoring or improving the international competitive position of the affected industry.

The bill also recognizes that, often, the adverse competitive impact wrought by targeting practices is not felt until _after_ those practices have ceased. For example, a foreign government may employ targeting practices in order to nurture the growth of one or more of its "infant" domestic industries. The targeting may stop, however, once those industries reach a level of competitive maturity which permits them to then unfairly displace their American counterparts.

Traditionally, the U.S. response to unfair trade practices ends when the practices themselves end. But we must not permit targeting beneficiaries to continue to reap the unjust enrichment of past practices which facilitated their penetration into the U.S. market. It may be appropriate to impose sanctions on targeting recipients and/or to provide compensation to targeting victims in such circumstances. Potent remedies would create a powerful deterrent by putting foreign governments on notice that their targeting practices will not be tolerated.

NMTBA is appreciative that both the Senate and House trade bills specifically identify foreign industrial targeting as an unfair trade practice actionable under U.S. trade laws, and that both bills establish a deadline on USTR decisions as to whether targeting exists.

The Senate and House bills differ, however, in their approach as to what to do about unreasonable targeting, once the USTR has determined its existence. The Senate bill requires the President to take action (including retaliation, negotiation to eliminate the targeting, compensation by the offending government or a domestic action plan for the domestic industry), unless he finds that taking such action would be contrary to the national security or the national economic interest. The House bill requires the USTR to take action in targeting cases involving a substantial burden on U.S. commerce, unless he finds that taking such action would be contrary to the national economic interest. In targeting cases not involving a substantial burden on U.S. commerce, the USTR would have unlimited discretion.

NMTBA strongly urges that authority to make decisions regarding what to do about targeting and other unfair trade practice cases should be statutorily conferred upon the USTR. Today's system of escalating every unfair trade practice case to the Oval Office creates too many geo-political pressures on the outcome of what should be trade and economic decisions. In addition, giving USTR statutory authority to make final decisions in targeting and other unfair trade practice cases will substantially increase his negotiating position vis-a-vis his foreign counterparts. The House has appropriately made USTR decisions in targeting and other unfair trade practice cases "subject to the specific direction, if any, by the President." This assures that, if the President wishes to become involved in a specific case, there is ample room for him to do so.

NMTBA also believes that the House's delineation between targeting cases involving (or not involving) a "substantial burden on commerce" is unnecessary. NMTBA prefers the Senate's requirement that the Administration take action in all targeting cases, unless doing so would be contrary to the national security or the national economic interest.

IV. EXPORT CONTROLS

The current export control system unnecessarily undermines U.S. competitiveness. The purpose of the U.S. export control system is to prevent certain high technology and defense-sensitive products designed and manufactured in the United States from being used or distributed overseas in a manner that would undermine our national security interests or contravene U.S. foreign policy objectives. It has been widely acknowledged, however, that all too frequently the application of export controls, authorized by the Export Administration Act (E.A.A.), has led to an unintended result: by creating a climate which, in effect, discourages U.S. export activities and undermines relations with our allies, the export control system has added significantly to the U.S. trade deficit. For example, a recent National Academy of Sciences study concluded that export controls "have greater potential to damage the U.S. economy than...reduce exports to the East bloc."

Machine tools have long been recognized as essential to military production and defense preparedness. Export controls imposed for purposes of national security have, therefore, a direct and often substantial impact on the machine tool industry's capacity to market its products in overseas markets. NMTBA recognizes the overriding need to maintain a defense-industrial edge over our potential adversaries. Relaxation of controls on equipment which would permit those adversaries to significantly and directly enhance their military capabilities is not a goal of the machine tool industry. However, the fact remains that, at a time of unprecedented competitive erosion, machine tool manufacturers, along with other U.S. industries once active in export trade, are virtually cut off from potentially lucrative opportunities involving the overseas sale of products and technologies which have no genuine bearing on U.S. national security interests.

The key export control issue for the U.S. machine tool industry is foreign availability. For years, NMTBA has brought to Congress' attention many instances in which U.S. exporters were denied overseas market access for products routinely available from non-U.S. sources -- often, in fact, from our own COCOM partners. Since Congress mandated the U.S. Department of Commerce Foreign Availability Office, it has assiduously made timely and accurate assessments of foreign availability. All too often, however, other departments refuse to accept their findings, thus delaying and sometimes indefinitely postponing the elimination of controls which no longer serve a useful purpose. Consequently, it should be clarified that once foreign availability has been clearly established, the Department of Commerce, as the primary agency charged with implementation of the E.A.A., has unilateral authority to decontrol the item(s) in question and that such determinations cannot be overruled or vetoed by the Department of Defense. Secondly, a time limit should be imposed on the foreign availability determination process. Thirdly, once a U.S. exporter has established that Western countries produce items subject to national security controls -- the burden of proof should shift to the U.S. government to show that shipments are not being made to Eastern Bloc destinations. Such a provision is reasonable, in light of the well-documented propensity of many of our COCOM allies to sell proscribed equipment in Eastern Bloc markets.

The number of controlled items should be reduced. The United States' imposition of unilateral controls on exports to "friendly" countries causes many potential foreign customers to turn to non-U.S. sources of supply. Once such market opportunities are lost, they are nearly impossible to regain. Subject to appropriate end-use restrictions, validated licenses should, therefore, no longer be required for most West-destined items which fall below the level of technology exportable to the People's Republic of China (PRC) without prior COCOM approval. Some of our COCOM allies maintain a system of export controls and enforcement which closely parallel our own. Validated licences should not be required at all for exports to these countries. Finally, items which fall below the level of technology exportable to the Soviet Union without prior COCOM approval should be removed from the U.S. control list.

Perhaps no element of U.S. export control policy has placed a greater strain on our relations with allies than requiring that reexports of U.S.-origin products and component parts be subject to U.S. approval. We believe the tension understandably generated by this requirement would be at least partially alleviated if reexport controls were eliminated on U.S. items transhipped within COCOM countries. The U.S. regulation of products sold and re-sold entirely within the boundaries of COCOM represents an unwarranted extraterritorial application of U.S. law.

The People's Republic of China is a burgeoning export market with promising long-term potential. The further relaxation of controls on items destined for the PRC would help U.S. exporters take advantage of the many commercial opportunities now available in the PRC.

Representatives of U.S. industry with relevant expertise should be included on the official U.S. delegation to COCOM for purposes of list review. This is the current practice in many of our COCOM partners.

We urge that the Trade Bill adopted by the Congress next year incorporate the export control reforms we have outlined above.

V. PRODUCT LIABILITY

The White House Conference on Small Business identified product liability tort reform as the number one concern for all small businesses. Unfortunately, at a time when this country faces an unprecedented trade deficit and when the machine tool industry is struggling to retain a competitive edge, the current product liability system is a serious impediment to both productivity and competitiveness to U.S. machine tool manufacturers.

The results of the NMTBA's annual product liability survey indicate that almost 25 percent of its members have no product liability insurance. For those fortunate enough to find coverage, insurance premiums have risen by about 50 percent since last year and have tripled since 1985! The cost of product liability is an expense taken into account by manufacturers when setting the price of their products. Because foreign product liability rules are much less cumbersome and substantially more defense-oriented than ours, the product liability costs borne by our foreign competitors in their home markets are significantly lower than ours.

The U.S. machine tool industry's exposure to liability for injuries associated with the use of older products is a factor which contributes prominently to this result. Foreign machine tool builders -- unlike their American counterparts -- do not face product liability exposure on their older products because their penetration into the U.S. market has been relatively recent.

American manufacturers and product sellers routinely pay premiums which are more than 20 times higher than those paid by their European competition. The competitive disadvantage is obvious. American products destined for overseas markets are necessarily priced up to reflect insurance costs which vastly exceed those incurred by foreign competition; here the product liability insurance rates for the foreign builder of those products are lower.

Defense costs account for a considerable portion of the insurance-differential burden borne by U.S. manufacturers. For example, general liability defense costs alone were $2.7 billion in 1984 -- an amount higher than the entire 1984 production of the U.S.

machine tool industry! In other words, American industry is forced to spend more on lawyers to defend it in liability suits than it spends on new machine tools to improve productivity and competitiveness.

The bipartisan leadership of the House Energy and Commerce Consumer Subcommittee has agreed upon a consensus product liability reform bill and a substantial majority of its members support it. Last year, 83 Senators voted to move ahead on this important issue. We urge that fair and balanced product liability reform be enacted by the 100th Congress.

VI. TAX LEGISLATION

A solid U.S. manufacturing base requires a healthy machine tool industry. Yet, the corporate tax structure inhibits capital-intensive, marginally profitable companies, such as machine tool builders, from investing in the capital equipment and engaging in the research and development necessary to successfully compete in global and domestic markets.

One example of the tax system working against many small businesses is the corporate Alternative Minimum Tax (AMT). The stated purpose of the AMT is to require profitable corporations to pay their fair share of taxes. However, the AMT has a very perverse effect on corporations that are both marginally profitable and capital intensive. Companies which invest heavily in improving America's productivity (and therefore make substantial use of accelerated depreciation) and which have relatively low profit margins, will fall under the AMT, because of the compression between the regular tax and AMT rates. Companies falling under the AMT are effectively denied use of accelerated depreciation on their equipment purchases, thus increasing their capital costs and reducing their competitiveness.

By substantially increasing the AMT base, the Budget Reconciliation Bill adopted by the House uses the minimum tax as a means to raise revenue. An attempt to raise revenue in this fashion will have an immediate negative effect on the competitiveness of American machine tool builders and their ability to invest in newer technological development. Our capital intensive customers will be similarly hurt. American competitiveness will suffer. Fortunately, the Budget Reconciliation Bill approved by the Senate Finance Committee rejects expansion of the AMT as a method of increasing revenues. We urge you to hold firm on this issue when the Bill reaches the Senate floor in a few days.

The 20 percent research and development tax credit is scheduled to expire on December 31, 1988. NMTBA believes that it should be reauthorized and improved. The current credit is weighted toward fast growing businesses and offers little or no R & D incentive to small growth, marginally profitable companies.

A portion of the credit's benefits should be shifted to those companies operating at low profit levels without disincenting more profitable companies. This could be accomplished by using 95 percent of a fixed historical base (1985-1987) and adjusting each subsequent year by the lesser of sales growth or the rate of inflation. Thus, by starting with a base of 95 percent rather than 100 percent of 1985-1987 R & D and by utilizing the lesser of the two indices, the credit could be made to provide incentives for both slow and fast growing firms and better target the first discretionary dollar of R & D spending by the firms.

VII. PUBLIC AND PRIVATE SECTOR PROGRAMS

The problems the machine tool builders face are being addressed to some degree in both the private and public sectors. Initiatives by all parties recognize the complexity of re-industrializing the manufacturing base of the United States and the fact that long-term planning is necessary. President Reagan's Domestic Action Plan to revitalize the machine tool industry is a giant leap forward. Attached to my testimony is a Department of Commerce compilation of programs and policies mentioned by the President or directly related to the objectives of the plan.

As current Chairman of the National Center for Manufacturing Sciences (NCMS), I would like to review this private sector initiative. The concern of the Department of Defense regarding the condition of domestic suppliers of process technology has played a significant role in the creation of the NCMS. The DoD recognizes the national security implications of an eroding capital goods industry. The mission of NCMS is straightforward -- to aid U.S. industry in regaining and sustaining manufacturing leadership in a global economy. This is to be accomplished by establishing national guidelines to promote cooperative research, avoid duplication, and tackle projects too large for individual companies. It is the kind of joint effort from which we will all benefit. NMTBA has donated $1 million in "seed money" to NCMS. We have commitments of over $4 million a year from over 75 interested firms and a contribution of $5 million a year in matching funds from the Federal Government.

The American machine tool industry may be down but is in no way willing to be counted out. The promotional efforts of the NMTBA have resulted in enhancing the competitiveness of its members. This year NMTBA formed the nation's largest export trading company. We became the first trade association to receive an export trading certificate for the entire membership and all of its products. Our small business-based industry can now prepare joint bids, establish export prices, allocate sales, jointly market and promote its products, coordinate service, exchange export information, and in many other ways cooperate to facilitate and increase the export of U.S. machine tools without risking anti-trust prosecution at home.

Also, NMTBA became the first trade association to receive risk insurance from the Eximbank and its agent, the Foreign Credit Insurance Association (FCIA), after their political and commercial risk insurance policies were broadened to cover trade associations. Our members with this insurance back-up will be able to offer extended credit terms to overseas buyers without requiring up-front cash deposits and other burdensome financial detailing. Again, the efforts of the NMTBA on behalf of its members and the welfare of America's most important manufacturing base -- the machine tool industry -- displayed the perseverance and stamina necessary to get up and fight back at foreign competitors wearing weighted gloves.

VIII. CONCLUSION

I hope my presence here today has provided this Subcommittee with some insight into the status and the needs of the builders of automated machine tools. It is evident that more efficient production technologies must necessarily be developed and implemented if the United States is going to compete successfully in an expanding global market. The American machine tool industry stands ready to do its part.

Judging by government actions, it appears that the United States is the only major nation in the world that does not recognize that its defense industry is a valued national asset and that it has the potential to be a major deterrent to aggression. The United States does not have a coordinated strategy for maintaining and improving its industrial base.

Our government does not have a coherent policy or a centralized program that is designed to preserve and restore the industrial base. It lacks an integrated approach for assessment of industrial base weaknesses, strengths, and development of solutions to industrial base problems.

A mandate from Congress is necessary to direct that government agencies work with the private sector to preserve critical sectors of the industrial base. I firmly believe that a nation cannot be a first rate military power with a second rate industrial base. It has never happened in the history of the modern world and, in my opinion, it never will. The Soviet Union recognizes this -- for they are giving first priority in their economy to the machinery sector of their industrial base. The machinery sector continues to realize the most rapid growth in the entire Soviet economy.

The continued deterioration of the manufacturing segment of our industrial base will not only reduce our ability to support our military forces, but will also destroy a credible deterrent and will ultimately lower the standard of living of every American. Action is needed now, on a national scale.

Thank you, Mr. Chairman, I would be pleased to respond to your questions.

ATTACHMENT

STATUS REPORT ON MACHINE TOOL DOMESTIC ACTION PLAN

The following programs were either mentioned in the President's announcement of the Domestic Action Plan to revitalize the U.S. machine tool industry or relate directly to the themes in that Plan.

DOD Research Programs

Purpose - To strengthen U.S. machine tool industry involvement with DOD research programs involving manufacturing technology.

Method 1: DOD ManTech Program - Establishment of machine tool technology development as a major area of focus within the DOD Manufacturing Technology (ManTech) R & D funding program. DOD has designated the Air Force as the lead agency to administer these research monies and award R & D contracts to private firms conducting machine tool research. A $30 million increase was added to the Air Force R & D budget request to Congress to fund this and related efforts.

Status - A DOD Machine Tool Technology Conference was held in June, 1987 to help the Air Force identify specific areas of machine tool and manufacturing technology most in need of R & D. Lawrence J. Rhoades, President of Extrude-Hone Corporation, was the conference chairman. About 300 persons from industry and government attended. NMTBA sponsored a follow-up conference to acquaint machine tool firms with government contracting procedures. The follow-up conference was held August 11 at NMTBA's McLean, Virginia headquarters. Both the House and Senate DOD authorization bills for fiscal year 1988 have provisions authorizing the $30 million program. Contact either John Deam and Charles Downer, NMTBA, at (703) 893-2900 or Veronica Gunther, Air Force ManTech Program Manager for Advanced Machining, at (513) 255-5151.

Method 2: University Research - To continue DOD funding of the University Research Initiatives (URI) program. DOD encourages U.S. universities to apply for funds to conduct research related to machine tool technology and the manufacturing sciences. Machine tool firms can team with universities in submitting proposals. The URI program is not limited to funding in these areas and priority is given to the most promising proposals. Approximately $10 million of URI funds currently are devoted to projects in the manufacturing sciences.

Status - Congress is considering a substantial increase in funds authorized for the URI program. Contact Mark Herbst, URI/DOD Program Manager, at (202) 694-0205.

Method 3: Index of DOD-Sponsored Research - Sharing existing DOD-sponsored machine tool technology. The Defense Technical Information Center (DTIC) will prepare an index of documents related to machine tools from their central database.

Status -Copies will be made available for the costs of reproduction. Contact either Bob Walk, contractor for DOD's Manufacturing Technology Information Analysis Center at (312) 263-7125 or (312) 567-4730 or John Deam and Nell Greene, NMTBA, at (703) 893-2900.

Civilian Research and Development

Purpose - Federal Government support to U.S. machine tool research and development.

Method 1: National Center for Manufacturing Sciences - The voluntary establishment by U.S. machine tool manufacturers and users of a research and development organization, the National Center for Manufacturing Sciences (NCMS), to undertake cooperative research and development on machine tools and the manufacturing sciences generally. James L. Koontz, President of Kingsbury Machine Tool Corporation, is serving as Chairman of the Interim Board of Directors. Progress on each research project will be monitored by special teams composed of member companies and results will be distributed to NCMS members. NMTBA is donating $1 million in "seed money" for the organization of NCMS and the Federal Government is contributing $5 million a year in matching funds for the next three years.

Status - NCMS has over 75 letters of intent from interested firms and commitments of over $4 million per year from these firms. Companies which have agreed to join NCMS include General Motors, Ford Motor Company, INTEL Corporation, General Dynamics, and Texas Instruments as well as many machine tool firms. Over 15 states competed for selection as the permanent headquarters site of NCMS. The selection committee recently chose Ann Arbor, Michigan as that site. The final version of the research agenda will be published within the next two months. Contact either John Deam and Charles Downer, NMTBA, at (703) 893-2900 or Carolyn Castore, Executive Secretary, NCMS, at (202) 457-0223.

Method 2: National Bureau of Standards - The National Bureau of Standards (NBS) will work with domestic machine tool producers to expand their involvement in the research programs of the Automated Manufacturing Research Facility and provide technology seminars on subjects related to this research.

Status - Two new projects both of which involve a machine tool firm and a software company will be announced this fall. Technology seminars will be delayed because of the International Machine Tool Research Forum already scheduled for this fall. Contact Dennis Swyt, Deputy Director Center for Manufacturing Engineering, NBS, at (301) 975-3401.

Method 3: Small Business Innovative Research (SBIR) - Federal agencies with over $100 million in external R & D contract authority are required to allocate up to 1.25% of these funds annually to an innovative research program for firms with fewer than 500 employees. Most of the firms in the U.S. machine tool industry qualify for this program.

Small firms can apply for a maximum of $50,000 in first-year seed money to develop grant proposals. If their proposals are accepted, research awards of up to $500,000 are available. The Small Business Administration oversees this program but each participating agency administers its own grants.

Status - For a list of SBIR coordinators in each agency, contact Paul Halpern, Program Manager, Commerce Department, at (202) 377-4761.

Method 4: National Science Foundation - To continue funding of the National Science Foundation's Engineering Research Centers (ERCs). This program is designed to provide financial assistance to universities engaged in or planning to establish centers for cross disciplinary engineering research including the manufacturing sciences. Manufacturing firms are encouraged to team with universities in submitting proposals to set up ERCs.

Status - Currently there are five ERCs conducting research related to manufacturing processes. They are located at Ohio State, University of Delaware, Purdue, University of California at Santa Barbara and University of Maryland. Contact Marshall. M. Lihv, Director Division of Cross Disciplinary Research, NSF, at (202) 357-9707.

Method 5: Joint Ventures - The Commerce Department will provide advisory services to firms seeking to form cooperative research ventures with other firms under the National Cooperative Research Act or the R & D Limited Partnership Program. The Department will also assist those looking for investors in these types of enterprises.

Status - NCMS has applied for and received status under the National Cooperative Research Act which grants limited exemption from anti-trust laws for joint R & D. Under amendments to the Act proposed by the Administration, anti-trust protection would be extended to some joint production activities. Contact Lance Felker, Director, Industrial Technology Partnerships Division, Commerce Department, at (202) 377-5913.

Productivity and Marketing Programs

Purpose - To provide Federal Government services that will help enhance the international competitiveness of the domestic machine tool industry.

Method 1: Financing Foreign Sales - The Export Import (EXIM) Bank and its Foriegn Credit Insurance Association (FCIA) have broadened their political and commercial risk insurance policies to cover trade associations as well as individual firms. NMTBA applied for an association policy that will provide all NMTBA members short and medium term risk insurance to cover exports to EXIM Bank-approved overseas countries. This risk insurance will make it possible for machine tool firms to finance foreign sales through bank loans to buyers. Previously, producers had to rely primarily on financing methods requiring foreign purchasers to deposit money up front.

Status - NMTBA became the first trade association to receive risk insurance under the new program when it was issued an association policy in January, 1987. Contact either Joe Franklin or Chuck Koella, NMTBA, at (703) 893-2900.

Method 2: Export Trading Company Certificate - Expedited treatment of NMTBA's application for an Export Trade Certificate of Review. In the past, the anti-trust laws have impeded U.S. export efforts by preventing firms with complementary but closely related product lines from engaging in joint export promotion and marketing activities. This certificate will give NMTBA's member firms anti-trust protection for joint export activities.

Status - In May, 1987, the NMTBA obtained from Commerce's Office of Export Trading Company Affairs an export trading company certificate. Contact Joe Franklin, NMTBA Administrative Director, at (703) 827-5201.

Method 3: Market Promotion - The Commerce Department will provide market assistance to domestic machine tool firms seeking to promote their products domestically or overseas. This assistance includes helping firms with:

- o forming leasing companies;
- o meeting with user groups to discuss user-vendor relationships;
- o completing export related paperwork;
- o establishing overseas sales offices;
- o assessing the suitability of products for export.

Status - NMTBA has received an initial $32,000 grant from the Office of Trade Adjustment Assistance in Commerce for work on promoting overseas markets for products. Contact Paul Halpern, Program Manager, Commerce Department, at (202) 377-4761.

Method 4: Training and Evaluation Programs - To assist domestic machine tool firms seeking to upgrade training or find new ways of evaluating productivity. Toward these ends the Commerce Department will:

- o authorize its National Telecommunications Information Administration to help the National Technical University in developing satellite-based course offerings on the application of computers and control technology to machine tools.
- o help arrange for use of productivity measures that allow a machine tool firm to compare its performance to other firms in the same industry on a series of productivity indicators.

Status - The training courses will be initiated when Federal funds become available. NMTBA is developing a proposal for this program in anticipation of Federal funds becoming available. NMTBA is also assessing the interfirm productivity evaluation system. Contact either John Mandl, NMTBA, at (703) 893-2900 or Paul Halpern, Program Manager, Commerce Department, at (202) 377-4761.

Expanding Market for Advanced Manufacturing Technology

Method 1: Navy Spare Parts Project - The U.S. Navy's Office for Rapid Acquisition of Manufactured Parts (RAMP) and the State of South Carolina are engaged in a joint project to develop and demonstrate advanced manufacturing technology. The project is building a testbed in Charleston, South Carolina to be followed by automated facilities to manufacture spare ship parts (Charleston Ship Yard) and electronic parts (Indianapolis).

Status -The Navy is interested in transferring the technology to the private sphere once it is developed and has an Associates program for private firms who are interesting in participating in the technology development. Congress has approved $60 million as initial support for the RAMP efforts. The joint venture will begin procurement of advanced technology machine tools in the Spring of 1988. Contact Forrest F. Hedden, Deputy Director, South Carolina Research Authority, at (803) 554-8004.

Method 2: Commerce Department - The Commerce Department will facilitate the formation of joint ventures and individual firms employing advanced manufacturing techniques by providing information on state and private funding sources and by serving as a clearinghouse on technical and marketing data.

Status - Several groups in different regions of the country are in the process of developing flexible manufacturing joint ventures. Contact Ted Lettes, Director, Small Business Technology Liaison Division, Commerce Department, at (202) 377-8111.

Procurement-Related Actions

Purpose - Provide U.S. machine tool producers with additional information on the defense procurement process.

Method 1: Defense Purchases - DOD distributes copies of the Defense Economic Impact Modeling System (DEIMS) outputs on projected defense industrial base purchases of machine tools over the next five years.

Status - The numbers in this report are reported at high levels of aggregation and may be of primary usefulness to firms with quantitative planning models. For more information about this document contact Burk Kalweit, NMTBA, (703) 893-2900. Copies of the DEIMS report may be obtained from Cynthia Gonsalves, Office of Industrial Base Assessment, DOD, at (703) 756-2310.

Method 2: Procurement Conference - DOD in cooperation with the Commerce Department and NMTBA will conduct an annual DOD Machine Tool Procurement Conference. This conference will provide a series of briefings by the military services on projected procurements of machine tools at their arsenals, shipyards, air logistics centers, etc. It will also provide information on planned major weapons system programs that may result in machine tool procurements by defense contractors. The conference will also cover DOD procurement procedures especially as they apply to small businesses.

Status - The first procurement conference is scheduled for the Spring of 1988 in the Midwest region of the United States. Contact Charles Downer, NMTBA, at (703) 827-5228.

Faster Export Licensing Procedures

Purpose - To implement "fast track" processing of license applications for exports of machine tools by the Commerce Department's Office of Export Administration.

Method: New Procedures - Development of expedited processing techniques for applications involving machine tool exports.

Status - Expedited procedures for the machine tool industry have been implemented. Contact Iain Baird, Director, Individual Validated Licensing Division, Commerce Department, at (202) 377-8536.

Legislative Developments

The following proposals are receiving consideration by Congress.

National Science Foundation Strategic Research - The National Science Foundation has requested a budget increase to start a new program called the Strategic Manufacturing Initiative (SMI) to fund research and development on advanced manufacturing technology. "High risk-high payoff" R & D projects on all aspects of the manufacturing process, including the design and building of machine tools, will be eligible for funding. Successful applicants will receive up to $500,000 per year for their projects. Although NSF primarily funds academic institutions, machine tool firms are encouraged to team with universities and submit joint proposals.

Status - NSF has requested $4 million from Congress to fund this effort in FY88. Contact John Meyer, NSF Program Manager, at (202) 357-7676.

Defense Advanced Research Projects Agency (DARPA) - The Senate Armed Services Committee has added a $50 million increase to DARPA's FY88 budget for the purpose of funding generic research on innovative manufacturing technology.

Status - If the budget increase is enacted, DARPA is contemplating establishment of a series of testbed "minifactories" run by consortia of businesses and universities. Contact Craig Fields, DARPA Deputy Director for Research, at (202) 694-3781.

National Institutes of Technology Programs - Congress is considering legislation proposed by Senator Hollings that would reorganize the National Bureau of Standards as the National Institutes of Technology and establish new funding programs for manufacturing research and transfer of technology through regional or state centers.

Status - The Senate version, S. 907, was passed as part of the omnibus Trade Bill. The House version, H.R. 2916, has received approval of the full House. A conference committee is expected to resolve differences between the two versions. Contact John Simpson, Director of Center for Manufacturing Engineering, National Bureau of Standards, at (301) 975-3400.

Senator LEVIN. Mr. Koontz, thank you. Mr. Mittelstadt.

STATEMENT OF ERIC M. MITTELSTADT, PRESIDENT AND CEO, GMF ROBOTICS CORP., TROY, MI

Mr. MITTELSTADT. Thank you, Mr. Chairman. Let me express my gratitude also for the opportunity to present our views, speaking both as president of the Robotics Industries Association as well as president of GMF Robotics, the leading company in that industry, on the importance of helping small businesses automate their manufacturing processes.

The importance of small business to the economic and social vitality of the country makes it essential that the same means of achieving greater productivity increasingly employed by larger manufacturers be brought within practical reach of the thousands and thousands of shops and plants, small industrial concerns, that support local communities all across the land.

It is to these small companies indeed that we look for continued growth and the generation of new job opportunities. We need not be reminded that it was the desperate need of domestic automobile manufacturers, as this decade began, to become competitive in an industry they once dominated that caused the resurgence of automation in the United States.

Improved productivity, better and more consistent quality, reduced manufacturing costs, these were the basic elements of a survival kit for the automative industry. In fact, of the nearly 30,000 robots in use in the United States, about 50 percent of those belong to the automotive industry alone.

I make these references in order to emphasize the fact that, from its mystique-shrouded beginnings in the early 1980s, modern automation, centered around the robot and robotic systems, has become a given in the competitive arsenal of major manufacturers. On their production lines today, and in their plans for tomorrow.

The important thing is, that ways must be found to convey the good message about automation to the small business entrepreneurs. And our inability to do this is undoubtedly our greatest impediment to helping small businesses gain the benefits for themselves that are more and more being realized by larger manufactures.

This lack of information or understanding is coupled with a fear among many small concerns that the introduction of automation into their shops would be difficult because of the expense and mainly the complexity associated with robots and other computer controlled systems.

They have heard about that complexity. They have read articles about the extensive planning, adjusting, debugging, and electronic hardware and software architecture and all the exotic rhetoric that engineers like myself like to build around high-technology projects.

And to them that sounds like trouble. They say, "What do I need with that kind of complicated grief in my little place with 10 happy employees and a foreman?"

We need to give the small entrepreneur an assurance that while it is indeed quite a complex operation to integrate large flexible automation systems—for example, a network of robotic painters with the resident assembly lines and a high-volume large manufacturing facility—there is no comparison between that kind of installation and placing a few stand-alone robots in his place of business.

But the same benefits derive, and are in fact immediately visible in the smaller plant. The example included in our written statement of the small welding shop in the core city of a larger eastern metropolis illustrates exactly these two things that I am talking about.

Here was a high school graduate, intelligent but not highly educated. He wanted to improve the performance of the shop he had taken over from his dad. He learned how to program the robot, and was able to use it flexibly to turn out several different kinds of products, more profitably to him, and with higher quality and timeliness for his customers.

To get these kinds of information to the people who can benefit most from it, the Government is needed. Of the 60,000 or 70,000 smaller industrial concerns that would gain measurably from using flexible automation, less than 5 percent have installed even one robot.

If it were possible for the robotics industry itself to develop programs of information dissemination to reach small manufacturers. And there are thousands of communities, the robotics industry would do it.

But the truth of the matter is that our young struggling industry with robot manufacturers straining to make a go of it cannot finance any information program of truly national dimension.

Because we are convinced that the automation of this critical segment of the national economy should start to happen now. We are all witnesses to what happened to our major industries who waited too long.

We would like to recommend an intensive, well coordinated education-marketing program aimed at getting the complete story across to small businesses.

We would further suggest the possibility of contracting an experienced expert mass marketing firm to develop, and possibly manage, such a comprehensive program aimed at providing small businessowners with the information they need to begin to automate.

Robotics Industries Association would, of course, be able and anxious to provide whatever assistance and counseling, coordination, source materials, and so on, that we were asked to supply.

Concurrent with such a program, or perhaps as part of it, we would suggest a series of seminars that would allow successful users to share their experiences with others. Others considering making the move to automation.

And the IRA, again, with our 300 members, who have a great deal of expertise drawn from both sides of automation operation, from the perspective of both suppliers and users, stands ready to help develop and implement such seminars.

On a longer range basis, we would like to urge the establishment of a great number of advanced technology centers to provide clearinghouses of information. Accessible by small companies to discover technology resources available to them.

In our written statement, a new program offered by the Commerce Department of the State of Michigan is cited. The Michigan Modernization Service. This heads in the right direction. But it is still not enough, and it will not answer what we think is the prime requirement for the lead information program, and that is immediacy.

Of equal importance and longer range support are the curricula and disciplines of American schools. In this changing world, educational structures and content must do what is necessary to keep up, to fit young people for the world they must manage.

Our Nation must make every effort to see that tomorrow's workforce has the automation skills to keep us globally competitive.

We believe that America's school system must place a higher priority on these skills. And that will be particularly important to small companies, who will find it more difficult than major industries to find employees in the future, with both automation experience and expertise, and appreciation of how important that expertise will be in the 1990s and beyond.

Students who understand automation will be the small business leaders of tomorrow. They will also be the manufacturing leaders who develop new applications of robotics and other automation technology in both industrial and nonindustrial environments.

We urge, of course, Government support for automation applications research by our universities and other institutions. And we applaud all Government efforts to provide improved training in the area of automation.

I know you would be puzzled if we failed to take hold of this opportunity to press for financial considerations that only the Federal Government can truly make work. In our written statement, petitions for some of these considerations, those we hope to be initiated, those we hope to be continued, and those that would reflect the general disposition on the part of Congress and the Nation's leadership to help this industry's customers, the robotics industry's customers, as such customers are helped by governments in Japan, Sweden, France, England and elsewhere.

Particularly does the Japanese Government help the cause of automation by such incentives as investment tax credits, accelerated depreciation allowances, low cost loans, national leasing programs. And in fact has always done everything it can to make the use of automation a feature of national enterprise.

Just about any company in Japan, if it consists of no more than a mom and pop, a couple of employees, and a homebuilt shelter where a machining center or two can operate, can get State help to lease or buy a robot.

It is nearly impossible for us to beat that kind of support, which has existed in Japan since the first robot built from American design was programmed and set in motion to create a competitive edge, that the Japanese have zealously protected ever since.

Our small business leaders are innovative and resourceful. Their prosperity is indispensable to the well-being of America. Our automation industry is talented and aggressive and fully capable of tending the competitive needs of the family-owned and independent industrial concerns that contribute so much to our economic and social health.

These hearings are a great encouragement to us. Your interest in making the industrial capabilities of our small business concerns the equal of any anywhere in the world, fills us with some reasonable hope that this can indeed be done.

And I would like to thank you again, for this opportunity to state our views, and to again assure you that the RIA and its member companies will help in any way possible to develop national programs to forward the use of automation by small business. Thank you.

[The prepared statement of Mr. Mittelstadt follows:]

STATEMENT BY ERIC M. MITTELSTADT
PRESIDENT, ROBOTIC INDUSTRIES ASSOCIATION
PRESIDENT AND CEO, GMF ROBOTICS CORPORATION
BEFORE THE
COMMITTEE ON SMALL BUSINESS
SUBCOMMITTEE ON INNOVATION, TECHNOLOGY AND PRODUCTIVITY
UNITED STATES SENATE
DECEMBER 2, 1987

Mr. Chairman and Members of the Subcommittee:

On behalf of Robotic Industries Association and GMF Robotics Corporation, I would like to express my gratitude for the chance to testify about the opportunities and problems facing small businesses in automating their manufacturing processes. It is our firm belief that small businesses must successfully automate if our nation is to retain its global manufacturing strength. Throughout America's history, we have relied upon small businesses to innovate, and from this innovation, we have seen new employment opportunities, better products, and a higher standard of living for our society. Yet, today we are placing barriers in the path of small business innovation in the arena of automation. These barriers, threatening as they may appear, can easily be overcome through a national commitment, a commitment that provides information resources, planning assistance, and financial incentives for small businesses to automate. The time for this national commitment is now -- before small businesses in America lose their competitiveness.

Consider the magnitude of the problem. Here we are in America, the world's most advanced industrialized nation. We have at our disposal one of the most productive technologies ever developed --- robotics. Today's robots are smart, fast, flexible and capable of producing an enormous range of benefits to the user company. Yet, of the 60,000 to 70,000 industrial concerns that would benefit from using robots, less than five percent have installed even one robot. A new study of automation in the Great Lakes states shows that less than three percent of companies with 10-49 employees are using robots today --- and there's no reason to think the figures are any higher in other parts of the country.

The failure of small businesses to automate not only hurts these companies, but it hurts the companies they supply products to, and ultimately, our society suffers. And yes, the robotics industry suffers, too. In 1986, our domestic robotics suppliers shipped $441 million worth of robots. This year, as purchases decline from our largest customer, the automotive industry, robot shipments are likely to be down more than 25%. Just a few years ago, our industry was growing at a rate of better than 30% a year. However, we are quite confident that the robotics industry will emerge from its current slump as companies in a wider range of industries than ever before learn about the benefits of automation. Increased usage by small companies would be a major factor in an upturn for the robotics industry.

As a nation, we simply cannot afford to let our businesses, small or large, fail to take advantage of the best technologies available. In the manufacturing arena, companies that don't take advantage of new technologies such as robotics have a much more difficult time remaining competitive. Companies that don't stay competitive can't create new jobs for our sons and daughters -- in fact, they can't even protect the jobs that currently exist.

Let me assure you that the domestic robotics industry can meet the needs of small manufacturers. The small companies in America that have successfully implemented robots are realizing numerous benefits. Higher output, reduced manufacturing costs, improved quality, greater flexibility, quicker response time to customer needs -- these are just a few of the key benefits created by robotics. And these benefits pay off on the bottom line. Let me share with you a few examples. Consider the case of Frost, Inc., a $15 to $20 million metal turning and assembly company in Grand Rapids, Michigan. According to a recent article in ROBOTICS WORLD magazine (November, 1987, pp. 19-21), Frost's recent automation efforts have produced the following benefits: increased sales per employee from $80,000 per year in 1983 to $164,000 in 1986; decreased required manufacturing space from 70,000 to 26,000 square feet; reduced average lead times from 12 weeks to four weeks; increased use of machinery by more than four times.

Frost, Inc. is certainly not alone. There's a welding shop in the inner core of an eastern metropolis with less than a dozen employees.

Until recently, the company was run by a young high school graduate who took over the shop when his dad retired a few years ago. When the city offered to put up some money to improve the employment opportunities in this rundown section of town, the young businessman decided to go for it, by way of flexible automation technology. He installed a welding robot, learned how to program it, and used its flexibility to turn out several kinds of jobs For example, one week he might arc weld steel components, and aluminum the next. This small step into automation proved so successful in increasing his business, he planned to increase his investments in robotics and machine vision technology, as well as hiring more people.

Yet another success story is the Dott Manufacturing company in the small town of Deckerville, Michigan. This $20 million dollar company recently purchased robots to make some 40 different car emblems for the large auto manufacturers. The result --- a four-fold increase in manufacturing productivity, enhanced quality, and greater customer satisfaction. One leading company official said that of all the equipment in the plant, the robots were the only machines working without breakdowns since day one. The company does plan to purchase more robots for additional applications as they expand their operations to further increase productivity and cost-efficiencies.

However, and this is a point I will soon address, the same company official noted that if there were tax incentives, this small business could afford to purchase even more robots and factory automation equipment.

I want to share one final example with you. A company with 40 employees in Saginaw, Michigan is guided by a small businessman who is one of the breed who makes decisions based on "gut instincts." Two years ago, his instinct told him that robots could help his company, so he purchased one. The robot performed beautifully, so last year he bought three more. Again, the robots came through with flying colors, improving productivity by two to three times. Best of all, the robots were great at making a variety of parts with just small fixture changes. This flexibility proved to be enormously valuable to the company in shortening its response time to customer needs. From "gut instincts" came facts: robots are uniquely skilled at performing certain tasks. This is the message small business owners across America need to hear.

The question we all must ask ourselves is why, if robotics can significantly improve the bottom line, if the technology can produce dramatic improvements in productivity, quality, and flexibility, why aren't more small manufacturing companies turning to robotics? What are the barriers that small companies face and how can they be overcome?

One of the largest barriers concerns the widespread misperception that robots are too complicated and expensive for small companies. Well-publicized examples of problems in debugging robot systems have left the impression that they didn't work out, when in fact the problems were just normal start-up problems. Nevertheless, such colorful publicity makes many small business owners shy away from robots, despite the fact that, as one key manufacturing executive has said, 98% to 99% of the robots in America today likely work from the beginning exactly as intended and meet customer needs. The rest of the robots do, too, when the humans involved solve the start-up problems. Still, there is a small business attitude that can be summarized as "if Ford and GM can't make robotics work without start-up problems, I can't ever make them work."

The truth is that robots are working out at Chrysler, Ford, GM and virtually every company, large and small, where they are being used. In fact, what often surprises the small company most is the simplicity of learning how to program and operate a robotic system. As for the costs of investing in robotics, they must be considered in light of the financial benefits. Companies successfully using robot technology have developed new strategies for cost justification, strategies that need to be discussed and shared by companies in every industry.

The best way of countering bad information is with good information. At Robotic Industries Association, we would like to see a national program to disseminate accurate information on robotics to small companies. We envision a series of seminars that would allow successful users to share their experiences with prospective users. Our association, which represents some 300 companies that manufacture and use robots, is ready and willing to participate in developing and implementing seminars on this topic. We are sure that once the true benefits of robotics are understood by small business owners in America, you'll begin to see a rapid increase in the rate of automation.

Seminars are only one part of the effort needed. We need to have an information clearinghouse for small companies to discover the resources available to them. For instance, several states currently have advanced technology centers or other types of assistance programs. In Michigan, one new program offered by the state Commerce Department is the Michigan Modernization Service. One of the "guinea pig" companies assisted by the Michigan Modernization Service was Lewis Metal Stamping and Manufacturing company. According to a recent article in the DETROIT FREE PRESS, the company increased its sales from $1.8 million in 1986 to an expected $2.5 million in 1987, due in part to the consulting help received. In fact, the company's achievements resulted in it being named "Entrepreneur of the Year" by the Small Business Council of the Greater Detroit Chamber of Commerce.

Surely other companies in Michigan and across the nation would benefit by knowing about the types of programs that exist and the success stories that have resulted.

These are just a few of the possibilities. We would recommend a well-conceived and coordinated "marketing program" aimed at getting the complete story across. We suggest contracting with an experienced, expert, mass-marketing firm to develop and possibly manage a comprehensive program aimed at providing small business owners with the information they need to automate their companies. We believe it is of critical importance to our national competitiveness and national security that more small businesses automate now. Unfortunately, the relatively young robotics industry is made up of primarily small businesses that don't have the resources necessary to finance the type of information program necessary. Nor does our trade association have the funds necessary to reach the 60,000 to 70,000 companies in America that should be using robots, though it has a tremendous amount of useful information available. Each of our companies does the best it can, just as each of the various national, state, and community programs do the best that they can to advance the cause of automation. Yet, the type of coordinated marketing effort that is needed, and needed today, can only be undertaken with the complete commitment of the federal government.

Another barrier that small companies must overcome in automating, and where the federal government can help, is the need to find employees with automation expertise. Our nation must make every effort to see that today's workforce has the skills necessary to keep us globally competitive. We believe that America's school system must place a higher priority on automation skills. "Computer literacy" is not enough -- we need to produce students who understand how automation works, the benefits that result, the pitfalls to be avoided, and the impact of automation on the workforce. Students who understand automation will be the small business leaders of tomorrow. They will also be the manufacturing leaders who develop new applications of robotics technology in both industrial and nonindustrial environments. Therefore, we support all government efforts to provide improved training and retraining programs in the field of automation, and to provide more support for applications research by our universities.

If we agree that it is in our national interest for small companies to automate, then we must also provide financial incentives to encourage these companies to make the needed investment in new technologies. In the United States today, there are about 30,000 robots -- a very small percentage of which are in small companies. In Japan, there are more than triple this amount, even allowing for national differences in defining a robot. One of the major reasons for Japan's success in installing robots is the financial incentives provided by the government.

Investment tax credits . . . accelerated depreciation allowances . . . low cost loans . . . national leasing programs . . . all of these have contributed to the robotics success story in Japan. With similar incentives, America's small businesses can accomplish even more than their counterparts overseas.

We are encouraged by the fact that these hearings are taking place. We are also glad to see new legislation from Congress such as the Competitiveness Enhancement Act of 1987 and the Technology Competitiveness Act of 1988. We would like to see the R&D Tax Credit made permanent at no less than 25% and extended if possible to start-up companies. Our industry is absolutely certain that with the right mix of national awareness, government action and commitment from business leaders, America will see a significant upturn in the automation of small businesses in the years ahead. As I have stated, we believe this is vital to the competitiveness of our nation, and to our future strength. We strongly believe that our national security is inextricably linked to our industrial well-being, and the role of our small manufacturing companies is a crucial one.

Once again, I would like to thank you for this opportunity to state our views and I wish to reiterate our pledge to help in any way possible in developing national programs to stimulate the use of automation by small businesses. I've attached further information about our industry and trade association for your review.

Thank you.

BACKGROUND

The industrial robot was developed in the United States in the late 1950s. The first installation occurred in 1961. For the next two decades, growth of the robot industry was slow in America. However, the Japanese recognized the tremendous potential of the technology and began making massive investments in robotics in the early 1970s.

By the early 1980s, American industry began to see the results of Japan's investment in robotics. Better quality cars, televisions, stereos and other products were coming out of Japan, thanks in large part to the quality and productivity improvements provided by robotics. The use of robots began growing rapidly in the United States --- from 6,300 installed at the end of 1982 to more than 20,000 at the end of 1985. The largest customer is the auto industry, which accounts for about 50% of the U.S. robot installations.

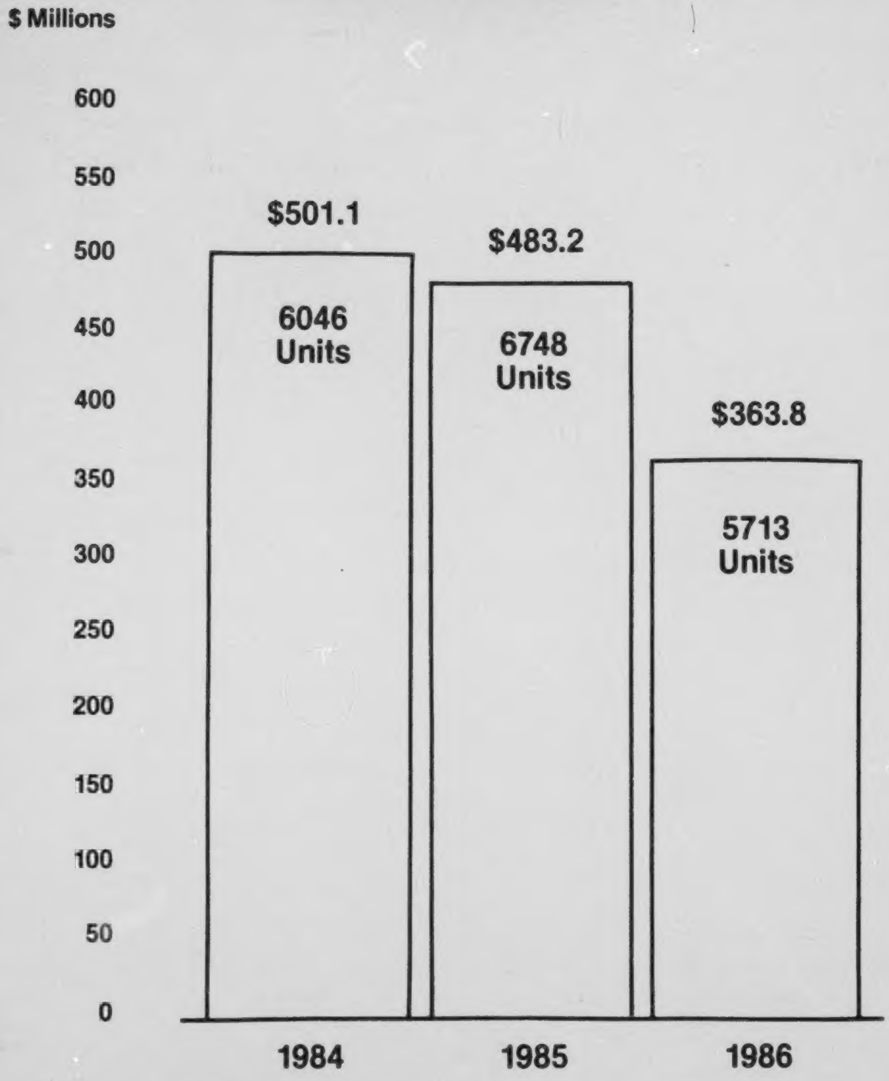
In 1986, the auto industry started reducing its capital equipment expenditures, having a severe impact on robot industry sales. Gross new orders for domestic robots, which peaked at $501 million in 1984, fell to $364 million in 1986. Further reductions in new orders are expected in 1987. As a result, the U.S. robotics industry has worked feverishly to diversify its customer base. This effort is beginning to pay off, with new customers in electronics, appliances, food processing, pharmaceuticals and many other industries now committed to robots.

However, the dollar volumes of customers in these industries hasn't yet reached the levels of spending common in the auto industry prior to the cutbacks. Instead of selling 100 or more robots to a large auto manufacturer, a robot supplier may sell one or two at a time to a new customer in the pharmaceutical industry, for example.

However, the future growth of the industry is dependent upon these small orders, particularly from small and medium-sized manufacturers. Of the 60,000 to 70,000 industrial concerns that would benefit from using robots, less than 5% have installed even one robot. The growth potential for industrial robots in the United States is enormous. As competitive pressure continues to mount on American companies, it is expected that we will see significant increases in the use of robotics.

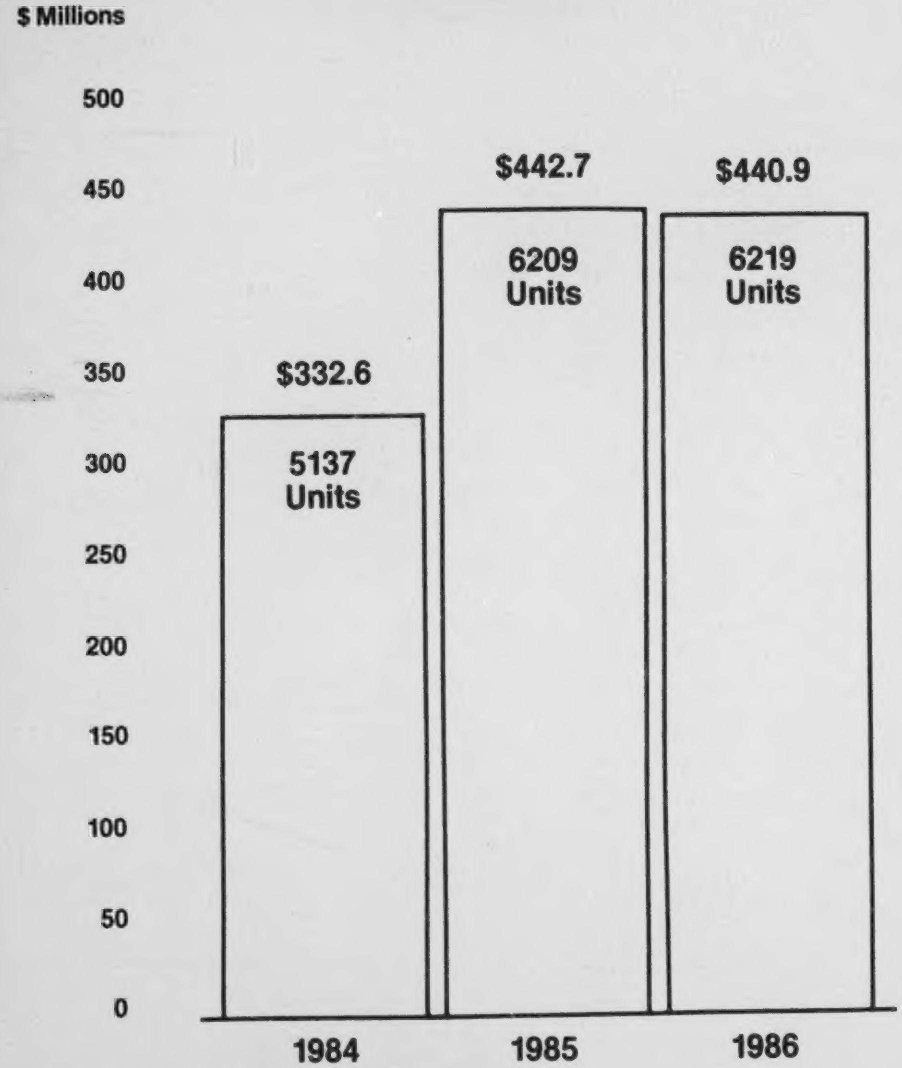
Because it is in the national interest to have flourishing small businesses that are able to compete on a global level, Robotic Industries Association believes that programs are needed to help small companies overcome the obstacles to automation. A national effort is needed to supply small businesses with information, expertise, and financial incentives so that increased automation takes place today. The longer we wait, the more we threaten future employment opportunities, the competitiveness of American industry, national security, and our standard of living.

Gross New Orders
U.S. Based Robot Suppliers
1984-1986



Source: Robotic Industries Association

Shipments by U.S. Based Robot Suppliers 1984-1986



Source: Robotic Industries Association

APPENDIX B

SUCCESS IN IMPLEMENTING ROBOTS REQUIRES A SYSTEMATIC APPROACH

Robotic Industries Association, the 300 member company trade group representing manufacturers and users of robots and related equipment, has developed guidelines for companies considering the use of robots. Our association is ready and able to assist any government agency or department in developing seminars and information resources for small businesses. Here's a sample of what we recommend as the sequence of steps to be followed for a first-time robot installation.

1. Initial Survey - review all factory operations and develop a shopping list of potential applications.
2. Qualification - reduce the shopping list to practicality, considering technical feasibility and justification potential.
3. Prioritization and Selection - determine which application to start with and what order to follow with the others.
4. Justification - develop economic and other rationale to support the decision to implement.
5. Application Engineering - do all of the engineering up to and including the final specification and selection of the particular robot to be used, the basic configuration of the workplace and a detailed description of the robot's task.
6. System Engineering - develop the total manufacturing system into which the robot will be integrated and all of the related changes to equipment, process and product.
7. Final Implementation - prepare the site and people, install and program the robot system, start up and monitor afterward.

(From Robotics for Senior Management, published by Robotic Industries Association).

CIM at Frost Inc.: A Management Strategy

Flexible automation helps company manage change; benefits are measured in business terms

Chad Frost, who led company's automation project from beginning to end, is pictured with a Yaskawa Motoman robot distributed by Roberts Corp., Lansing, Mich.

Frost Inc., a $15- to $20-million metal turning and assembly company in Grand Rapids, Mich., has implemented flexible automation as a means of introducing and managing change. With the help of Amprotech Inc., a management systems integration subsidiary, Frost developed and implemented an automation plan that supports its business objectives. The result is a successful implementation of automation that paid for itself while making the company a low-cost producer of its traditional products. The automation project also has resulted in improved quality and customer service and has provided the flexibility necessary to diversify product lines using existing equipment.

Frost has increased sales per employee from $80,000 per year in 1983 to $164,000 in 1986, decreased required manufacturing space from 70,000 to 28,000 square feet, reduced average lead times from 12 weeks to four weeks, and increased the use of machinery by more than four times. The sales-per-person figures are even more remarkable considering they were achieved with worldwide price competition over the same period resulting in price decreases of 27 percent (before adjusting for inflation).

The driving force for the company renovation was a predicted change in its traditional markets. Frost had experienced a six-fold sales increase throughout the 1970s, but by 1979 the company could see the end of growth in its market niche. Diversification was necessary to continue growth. In 1979, President and CEO Chad Frost led his company through an unsuccessful attempt at diversification. Company personnel resisted the change necessary for successful diversification, even when the new products were seemingly close to the old products in design and methods of manufacture. Thus, the company needed to alter the relationships among people and update its manufacturing tools and office systems to enhance the capabilities to adapt to change.

In 1982, Chad Frost began to investigate automation. He tried to find a consulting company that could lead a company-wide automation project, from beginning to end, and which would measure the results in business terms rather than just successful equipment installation or a "leather-bound report." Several companies quoted automation and business planning projects, but all were too expensive and none offered to lead the project from beginning to end.

In 1983, the CEO appointed a team of company personnel to lead the automation process. They were the same people the company relied on for daily production and to "put out the fires." These people were selected, according to Frost, because they were the most qualified people in the company. Unfortunately, even the most qualified people can take only so much pressure and can work only so many hours. The project finally came to a stop. It was decided full-time experts were needed.

In the summer of 1983, Chad Frost formed Amprotech Inc. to fill this need. Amprotech's goal is to provide affordable and effective automation that is easy to understand, easy to use, defined in business terms, and with results measured in business terms.

Amprotech recommends automation based on business reasoning and implements new methods by working with the top management and all levels of a company. Companies in the process of renovation must continue producing during the renovation. With the help and support from Amprotech project leaders functioning as staff, Amprotech allows presidents and upper executives to lead the automation projects comfortably and effectively.

To assure understandable communication throughout the organization, Amprotech translates technical jargon into the client's business language. This is necessary for complete understanding and conversation among the people who will be using the tools in their daily work tasks.

Guidelines have been developed from the experience gained in the Frost project and subsequent projects. These support the running of automation projects by the top management of the company and are as follows:

- Acronyms are avoided in the top manager's offices and on the office and factory floor.
- Automate for business reasons only.
- The automation plan must integrate with the company business plan.
- The automation project should have a normally accepted capital expenditure payback.
- The new methods, machines, computers and systems should be explainable in simple everyday business language.
- The use of the new tools and computers should be explainable in terms of how the tools and computers are actually (physically) operated after they are installed.

Having successfully planned and implemented its automation project using these guidelines, Frost has changed from a traditional hierarchial organization to one of reduced management layers, making communication and decision-making faster and easier. This new approach has resulted in the creation of four area managers (vice president level) positions responsible for internal operations, external operations, finance and human resources.

The company provided mandatory education and training to employees throughout the project. This started with education on why change was necessary and continued throughout the project on all levels.

Area managers oversee the functional managers, who are in charge of functions that run the company (i.e., purchasing, scheduling, design engineering, etc.). Functional decisions are delegated to these lower levels, along with the authority and responsibility for their implementation. Many of the traditional daily tasks have been automated, allowing more time for handling exceptions and decision analysis by people actively involved in the affected area.

The functional managers work with each other and with area managers as needed to evaluate the decisions on a company-wide basis. This does not mean there are no controls in the decision process — decisions are reviewed with upper management on a normal basis. At Frost, the decision "chain of command" is reviewed periodically to insure the process is working effectively. The result is more time for planning.

The company provided mandatory education and training to employees throughout the project. This started with education on why change was necessary and continued throughout the project on all levels. This management approach allows for quick response to opportunities and more involvement by more people in the company, and results in greater job satisfaction.

Today, Frost Inc. operates as if all company functions were located in one room. As a computer-integrated company, every function has full data access to history, the current situation, and what will happen when given solutions are used to solve a problem or to transact a given task (simulation). Many of the routine tasks, jobs and transactions occur automatically to provide time to strategically plan for optimal performance and to address exceptions as they occur. Each function has the responsibility and the tools to perform simulations and to produce efficiently using real-time systems.

Changing Frost into an automated, computer-integrated company was as complex as the hardware and software tools used in the automation. While significant time and energy were spent in rethinking every process in the company, more time was spent on motivating employees to accept and implement the change.

Extensive studies of company plans, strategies, functions and methods led to a basic business plan to guide the automation plan. Continuity of business and automation plans was critical to providing the proper tools for future operations. These plans are living documents — ever changing to meet the current needs of the company.

Changing the culture and philosophy of the company was one of the important elements in the automation implementation process. This job is never done. First and foremost was the concept of functional management, with each function in the company rethought and redefined. Only the best qualified people were assigned the functional responsibilities and authority. Next was horizontal management, which put the functional experts shoulder to shoulder. Third was the networking style of solving problems, where those people involved or affected were understood to be the best ones to solve any given problem.

These three concepts are interrelated and were implemented together. The result was trust among the employees and pride in themselves. These three elements were necessary for successful implementation of automation at Frost. After this change, rethinking and changing how each function was performed went smoothly.

The next critical element was education. Courses had to be well conceived, planned and executed. And they had to be high level, high quality and given on a timely basis. The project started with education on why change is necessary and continued throughout the project on all levels as it integrated the needs of the project with the needs of the people responsible for the operations of the company. Education was integrated with management style, company culture, people, computers and automation tools. The importance of effective and timely education to support the implementation of automation is paramount.

The application of technology and the selection and implementation of automation tools was executed by experts in their respective fields. Leadership and guidance were supplied by the automation project team to ensure the automation tools fit properly into the concept of the automation and company business plans. The implementation was accomplished by educating the people responsible for operating the new tools, and then using those same people to bring the automation tools into production with project team guidance.

Frost Inc. automated for several reasons. First, to reduce the break-even cost of producing current and future product lines by: reducing the labor content and requirements, improving productivity of people and capital assets, increasing utilization of people and capital assets, implementing hands-on functional management, and using computer integrated automation. Second, to provide people with time, tools and facilities to concentrate on diversification. And finally, to change the company culture to a drive for excellence by providing the tools for people to achieve it.

At Frost, a key element in successfully managing the process of automating the company was the in-depth participation and leadership of the CEO. Chad Frost uses the M.B.W.A (management by walking around) management style. This is a never-ending job for the CEO and the company. Change is now a way of life, an ever-present fact of business reality. Frost has chosen computer-integrated automation as the way to manage change.

APPENDIX D

ROBOTIC INDUSTRIES ASSOCIATION

Founded in 1974 as the Robot Institute of America, Robotic Industries Association is the only trade group in North America organized specifically to serve the field of robotics. Its 300 member companies include leading U.S. robot manufacturers, distributors, accessory equipment and system suppliers, consulting firms, and research organizations. Also, the association includes more than 60 leading robot user companies, from Fortune 500 size to small and medium-size organizations.

Of primary interest to RIA is developing useful information resources to user and potential user companies. Among these are pamphlets with guidelines on implementing robots; seminars on various topics of importance; films, videotapes, and books; statistics; and trade shows featuring the latest products and services from around the world.

Standards development is another major RIA effort. In 1986, RIA developed the first American National Standard on robot safety. Currently, we are developing draft standards on robot performance, communications, and other issues of importance to the user community.

In 1984, RIA recognized that the industrial robot was just one element of the science of robotics.

That year, we added two specialty trade groups under the RIA umbrella: the Automated Vision Association (AVA) to promote the use of machine vision, and the National Service Robot Association (NSRA) to promote the use of service (or non-industrial) robots. Both of these trade groups help RIA provide useful services to companies seeking to automate their operations.

As we move into the future, we will see more and more automation by small, medium and large businesses in non-industrial areas. Health care, education, space and undersea exploration, and agriculture are just a few of the areas where robotics will play a major role.

Individuals and companies with questions about the robotics industry are encouraged to contact Robotic Industries Association. It is our firm belief that the more the public knows about robots, the more useful applications will be developed to serve mankind.

Robotics for Senior Management

Guidelines for improving productivity and profitability...

A management approach to implementing industrial robots

Introduction

These guidelines for senior management have been prepared by the Robotic Industries Association to provide a better understanding of industrial robot technology and to describe the impact of industrial robots on a company's operations and strategies.

The recommendations are based on the experience of robot implementers and users who have integrated industrial robots into their manufacturing strategy and their factory operations.

The Opportunity

Leaders in most industries consider industrial robots as key elements in their manufacturing and business strategies.

Robots are no longer considered only as replacements for workers in the factory. Senior management recognizes that potential benefits impact all aspects of manufacturing—productivity, flexibility, quality—and that robots can give them the competitive edge necessary for survival.

> *"It is a must to manufacture competitive, low-cost products with world-class quality if we are to survive."*
>
> Joseph F. Engelberger
> Chairman
> Transitions Research Corporation
>
> From the new RIA film "Commitment to Robotics."

The Robotics Industry

Now in its third decade, industrial robot technology is still underutilized and misunderstood.

What is an industrial robot?
The Robotic Industries Association defines the industrial robot as "A reprogrammable, multifunctional machine designed to manipulate material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks."

What can robots do?
Robots are capable of performing a wide variety of part and tool handling tasks, such as: material handling, machine tool loading and unloading, tending die casting machines, tending stamping presses, investment casting, forging and heat treating, plastic molding, buffing/sanding/polishing, resistance welding, arc welding, laser cutting and welding, spraying, adhesive and sealer application, machining, water jet cutting, inspection and assembly.

Who uses robots?
Robots are used in many industries, including: automobiles, food processing, pharmaceuticals, farm and construction equipment, primary metals, foundry, home appliance, office equipment, aerospace, and electronics. They are used in industrialized countries worldwide and especially in countries which compete strongly with the United States, such as Japan, West Germany, England and France.

What is the Robotic Industries Association?
RIA is the only trade association in North America organized specifically to promote the use and development of robotic technology. It represents leading U.S. robot manufacturers, distributors, corporate users, accessory equipment and systems suppliers, consultants, service companies and research institutes. RIA sponsors trade-related meetings, workshops, seminars and expositions and plays an active role in establishing industry standards, publishing and distributing current robotics information, reporting statistics and representing the robotics industry to government, industry, academia and the media.

The Need For Commitment

Senior management must be the champion of robotics.

Implementing industrial robots requires total company commitment, championed by senior management. It is their responsibility to:

- ☐ Establish and state the overall objectives of robot implementation, as both a manufacturing strategy and an overall business strategy.
- ☐ Develop policies and issue statements on:
  - ☐ economic and other justification for robot implementation
  - ☐ long-term commitment to the robot implementation program
  - ☐ handling of displaced workers
- ☐ Be highly visible as champions, to:
  - ☐ overcome middle management inertia
  - ☐ support the efforts of the robotics implementation teams
  - ☐ provide resources as well as moral support

> *"One of the things I'd like to share, speaking on behalf of Chrysler, with my peers in the American industrial segments, recognize that you and I are in a global competitive fight. Robots can help you win on the major priorities of quality, productivity, flexibility and customer satisfaction. When you consider economics, robots are a must in any industry."*
>
> Richard E. Dauch
> Executive Vice President - Manufacturing
> Chrysler Motors

From the new RIA film "Commitment to Robotics."

The Learning Process

Management must establish the climate essential to the learning process.

The implementation of robotics requires an open, supportive environment. Senior management can enhance the chances for success by:

- ☐ Assigning people to the robotics team who are interested in new techniques and welcome change.
- ☐ Beginning with simple applications.
- ☐ Defining the parameters of the project and avoiding the temptation to expand.
- ☐ Being supportive and avoiding the punitive pressures which inhibit the learning process.
- ☐ Being patient.
- ☐ Planning for replication so that the business can profit from the learning curve.

The Implementation Process

Success in implementing robots requires a systematic approach.

The successful implementation of industrial robots is best accomplished through a systematic, multi-step process. The sequence of steps for robot implementation are as follows:

☐ Initial Survey—Review all factory operations and develop a shopping list of potential applications.

☐ Qualification—Reduce the shopping list to practicality, considering technical feasibility and justification potential.

☐ Prioritization and Selection—Determine which application to start with and what order to follow with the others.

☐ Justification—Develop economic and other rationale to support the decision to implement.

☐ Application Engineering—Do all of the engineering up to and including the final specification and selection of the particular robot to be used, the basic configuration of the workplace and a detailed description of the robot's task.

☐ System Engineering—Develop the total manufacturing system into which the robot will be integrated and all of the related changes to equipment, process and product.

☐ Final Implementation—Prepare the site and people, install and program the robot system, start up and monitor afterward.

> *"We look at the total manufacturing system and define it very, very detailed, task by task. Then we look at these tasks and try to interweave new technologies..."*
>
> Howard Kutcher
> Senior Technical Specialist
> Alcoa Corporation
>
> From the new RIA film "Commitment to Robotics."

Justification

Justification for industrial robots must consider both economic and non-economic issues.

The implementation of robots requires significant resources—money, time, people and management attention. The returns must be measured in terms of the overall benefits to the company, not simply by payback period or return on investment. Following are elements of the costs and benefits of robots:

☐ Initial Costs
    ☐ the robot and its tooling
    ☐ facilities, equipment revisions and rearrangements
    ☐ application engineering
    ☐ process and product changes
    ☐ training and transfers
    ☐ installation
    ☐ launching
☐ Continuing Costs
    ☐ cost of capital
    ☐ taxes and insurance
    ☐ maintenance labor, supplies and spare parts
    ☐ energy
    ☐ training
☐ Benefits
    ☐ improved quality and reliability
    ☐ increased flexibility
    ☐ stronger competitive position
    ☐ reduced direct labor costs and related expenses
    ☐ lower indirect costs
    ☐ depreciation
    ☐ safety and potential cost of disability
    ☐ increased productivity
    ☐ advancement of technology
    ☐ savings on scrap and rework

> *"We've reduced 18% of our equipment costs and we've also reduced our quality associated costs 50% in the areas robots are involved in."*
>
> Richard E. Dauch
> Executive Vice President - Manufacturing
> Chrysler Motors
>
> From the new RIA film "Commitment to Robotics."

Human Factors

Senior management must be aware of and sensitive to employee concerns about robots.

The impact of robots will be felt plant-wide. Senior management must be aware that employee concerns are related to their functions and are not all alike:

- ☐ Production management—interested in the robot's contribution to solving productivity, quality and work force problems, but not necessarily its contribution to profits.
- ☐ Production supervision—concerned with keeping the lines running and interested in backup plans and maintenance support. Must have answers to workers' questions about displacement, safety and the future.
- ☐ Skilled trade workers—may need upgrading of basic skills. Need specialized training and proper tools to keep the robot systems operating.
- ☐ Direct and indirect labor—Fear possible loss of employment. Need clear policy statement regarding displacement and opportunities for retraining and reassignment.
- ☐ Administrative and staff—Need definition of their responsibilities and recognition of their importance to successful implementation.

Conclusion

Industrial robots can be significant factors in the improvement of productivity, quality, profitability and, indeed, survival and should be an integral part of every manufacturing and business strategy.

Successful implementation of industrial robots is not easy. To encourage success, it is up to senior management to provide the vision to see how vital robotics technology is to manufacturing today and in the future, the climate and resources necessary for implementation and the motivation to make it happen.

"Robotics technology can help keep American manufacturing competitive today... and in the future."

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Executive Vice President
Robotic Industries Association

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Senator **Levin**. Thank you. One of our first panelists indicated that automation ought to sell itself basically. That some of the national programs they have in Japan maybe should not be necessary.

Why do we need an information program to small businesses? Why does advanced technology not sell itself?

Mr. **Mittelstadt**. Well, it is not that easy. There are too many cases where you can read it in the headlines about the problems that even big companies have with automation. Those generally tend to be debugging kinds of problems. But that gets left out of the headline.

And all too often a smaller company, as I mentioned, kind of gets intimidated by that and says, well, gee, if General Motors, Chrysler or Ford cannot do it without problems in the debugging stage, how am I ever going to do it?

And I think the thing that we need to do is get across those examples of small companies that have in fact done it. The half dozen or so that I mentioned in my written testimony, as well as others.

Senator **Levin**. Give us a couple of examples for the record. Say, from back home in Michigan, some companies that have succeeded in this.

Mr. **Mittelstadt**. There is a company in the western part of Michigan that has done that very effectively. Frost Industries, I think, was the name of the company.

They have done a nice job of planning a strategy for manufacturing automation that is consistent with their overall business strategy. They have significantly increased their business as a result, and significantly increased their productivity.

They set about doing it in a very planned and organized way. Perhaps somewhat larger of a company in that case than the welding shop I mentioned in the eastern city, as a matter of fact. Although we have had examples of those kinds of things too.

I think the key point, perhaps, to get across is that the automation technology can be like that company in Michigan used, a very total strategy that really looks at lots of interconnected systems. Maybe a higher-tech kind of a solution. Then is also capable of being applied by other even smaller firms.

And it is that 60,000 or 70,000 firm number that I am speaking of that really presents the problem.

Senator **Levin**. Anytime you are talking about a Federal program or a national program, no matter how small and modest, you are swimming upstream these days.

Mr. **Mittelstadt**. I understand.

Senator **Levin**. And you have to not only make out a clear case, you have to show why the private sector cannot do it. And, of course, you have got to find funds for it as well, although the amounts really are so small that they may not even show up on a budget line.

But putting that aside, and there is a funding problem, and we will try to reduce the deficit. There is also the question of why the private sector cannot do it. The first item that you mentioned was the information dissemination question.

And I would like to maybe get Jim Koontz's response. You are now head of a national center. You are going to be raising some funds. You have already gotten some matching grants.

You have done a wonderful job of putting the center together, you and a number of other people. Talk about that kind of a use of funds, for disseminating information. For instance, do you agree that that would be a high priority for your kind of center?

Mr. KOONTZ. Well, very definitely. We talk about the funding of high technology. But the real concern at the moment is the actual funding of programs for the training of management and people to understand the technology or how to apply or how to use the technology.

And it is more the implementation or the education of how to innovate, or how to implement it into the manufacturing base that is probably more important than the technology itself.

One of the real problems is not only, I'll say first, that the problem is money. Obviously the cost of technology today requires capital formation in order to get it. But the next important problem is education. We really do not have a supply of people who understand how to implement technology.

There is a very limited supply. As an example, take the Saturn Program. Probably the biggest failure of the Saturn Program is that there really were not the people around any longer who actually knew how to get the program off the ground.

Senator LEVIN. You were sitting here where we are? If you were able by yourself to implement one or two national programs that Government could take a role, in what would those one or two programs be?

Mr. KOONTZ. Well, I am torn between a couple of very good ones. I think the biggest thing the Government can do for the long range is to adopt a national platform.

I will give you a suggestion of one. Take the one that is led by John Young of Hewlett-Packard, the industrial competitiveness commission, adopt that as a national policy and get on with setting the guidelines and direction. Many times we have been successful in the past with, say, the Space Program as an example.

It has been when the Administration or the Congress has chose what we are going to do, and have set a national program of encouraging engineers and other people to change direction, in this case, to manufacturing. In the example, manufacturing companies relating to the Space Program. It was very effective.

We realized the end result of the Space Program when it was over, many of them went on to become meter readers. But that was not the point.

The point is that we can get direction from the setting of a national platform, believing the Industrial Competitive Commission's answers that John Young has led. And then from there the next step would be to obviously take a look at some of the capital formation policies.

If you are going to talk about small business per se, capital formation ideas, they do not have to necessarily be in current form. I would like to see the ITC back in place. Somehow we have to put capitalization in a form exceptible by small manufactures. So capitalization, if you want to get things moving, is definitely an important stage.

In my own company I would like to go ahead with the CIM Program. I am one of only 100 users of MRP-2. But the industry keeps talking about CIM as though it is already on the shelf.

Senator LEVIN. Tell us what those are.

Mr. KOONTZ. MRP is a materials requirement planning tool, which is sort of the first stage for (CIM), which is computer integrated manufacturing, CIM is the big buzzword today. Only 100 or some companies are Class A users of the Material Requirements Planning-2.

MRP was a $3.5 million project for me. These are not simple. CIM is probably a $6 million project for me. I am not moving too fast to computer-integrated manufacturing, the next step, for one very reason.

That is, it is so expensive and still very risky. There is still uncertainty as to whether the vendors really understand what it is. So there is a lot of, getting back to the information phase again, there needs to be a lot of work done to establish the credibility of what is computer-integrated manufacturing. So, to make a long story short——

Senator LEVIN. Thank you. I am going to interrupt there and now turn to Senator Kerry.

STATEMENT OF HON. JOHN F. KERRY, A U.S. SENATOR FROM THE STATE OF MASSACHUSETTS

Senator KERRY. Thank you, Mr. Chairman. I appreciate your interrupting. Unfortunately, my schedule does not allow me to stay as long as I would like. And I apologize to all the panels for that fact.

I think this is a very, very important hearing on a most important subject. And I thank all of you for taking the time to share your thoughts. And I thank you, Mr. Chairman, for presenting us with this opportunity.

I have read Dr. Jaikumar's Harvard Business Review article some time ago. And I was really struck by, not only the concept overall, but by some of the problems that we face in it. And I was particularly struck by his pointing out that I think in this country it takes us something like 25,000 person-hours and 2½ or 2¼ to 3 years to implement a system versus Japan, where they put it in at about 6,000 person-hours.

Underscoring management problems, and even when the system is up and on line, I understand the Japanese manage it more efficiently so that they are able to go off and engage in marketing and sales and other concerns, rather than just making the line work correctly.

Therefore, when I hear you say, gee, we need the Government assistance here, or some ingredient in terms of capital formation, it illustrates perhaps what I think is an increasingly overlooked ingredient of what is wrong in the American businessworld today. And I wonder if you would comment on that.

Is it really the cost of capital? Is Government effort to make that capital more readily available the sine qua non? Or are we missing something else in our competitive undertaking, in our spirit, in our whole approach to these matters? And I wonder if I could just throw that out?

Mr. KOONTZ. Senator Kerry, there is more. As I in my comments said, there is a more deep-rooted problem that has been going on for a number of years.

And it comes really, I will make a long story short. We had no competition after World War II. In essence we had competition, or at least we thought was competition. But only from the guy down the street. Not necessarily international competition.

And therefore we operated in an environment of limited international competition. I was also commenting that this allowed our educational system to drift away from the real problems of creating manufacturing engineers and engineers. 30 years of neglect is our major problem.

It is going to take us a while to reconstruct that situation. That is the major problem. But you have to survive in the meantime. And in surviving in the meantime, of which the industry is not doing too well, the whole manufacturing base for that matter, needs, if you want to pump it up, obviously improved capital formation is the quickest way to get the industry back onstream.

But, you do have to solve other long-range problems. Education, get more people interested. Engineers, get the majority of the engineers in our university research labs to be Americans, not foreign nationals, which 60 percent of them are today.

It is a long-range change. And that is why I say we need a national platform that directs itself and pays attention to those long-range issues, and provides us some incentives to stay in operation long-enough to do it.

Otherwise, I read an article not too long ago, it stated—and I believe that by the year 2000 we will not be registered in the top five manufacturing countries in the world. We have a problem. It is a long-range problem.

Senator KERRY. In keeping with that comment of yours then, I wonder, you know, we always hear whenever many of us here in Congress are trying to propose one program or another, people come up and say, well, do not do that. And they extol the virtues of the private sector, which all of us believe in. And we are constantly criticized, in fact, for meddling.

Why is it that the private sector does not seize on its own initiative here? You know, real interest rates have never been higher in this country. Why do those who are interested in commercial investment not make greater effort to perhaps reduce the spread? Or initiate programs of their own, which might reduce the cost of capital? Or look towards longer-term investment?

I mean, I am puzzled by that. On the one hand we extol the virtues, and on the other hand we slap the hand of Congress every time it interferes. And on the third hand, wherever we find that third hand, we come up here and say, but we do need your help and without it we seem to be struggling.

Mr. KOONTZ. We obviously did not necessarily need the Government, but to put it the other way, the Government came in, in the tax bill, and small businesses have suffered from the last tax bill, no question about it. If you heard me, I said that the net effect of capital investment today is actually a 50 percent premium on cost-of-investment. Had Government not been there, we might have fared a lot better.

So, in a sense, you are now in, we would have liked you to have stayed out 2 years ago, I mean, to get very pointed about it, Senator.

Senator KERRY. Well, I understand that.

Mr. KOONTZ. Now we have the problem, and we are asking you to either retake a look at that or find other ways we can generate capital.

I want a CIM, I want the computer-integrated manufacturing shop. Right now I have to go a little slower. I can only afford so much capital. At the same time, you have found ways, because of small business, under the minimum tax bill, of taking away some of the things I have used for capital formation, like deferment of my—just to give you a good example, my executive bonuses were deferred in the past, which puts capital into the company, which I used for further investments. You now are going to make me include that in my tax base.

It makes no difference how I pay taxes, but in the end you have to find ways for me to continue to formulate capital. Keep in mind that the bottom line is not what is important in small businesses, even though I have to remain profitable, but if you expect me to invest and grow, I have to have capital, not profits necessarily, I have to have capital. I have to generate cash, and I have to see a future, and I am even questioning whether I see a future in the long range direction.

Anyway, that is the issue.

Senator BUMPERS. John, would you yield for a question?

Senator KERRY. Absolutely.

Senator BUMPERS. Mr. Koontz, let me ask you how you square what you just said with your statement on page 4. You say that during the last 2½ years, Hughes, LTV, what is that, Watervliet——

Mr. KOONTZ. Watervliet Arsenal. That has to do with Government.

Senator BUMPERS. General Dynamics and Lockheed have all purchased flexible manufacturing systems——

Mr. KOONTZ. Yes, they have.

Senator BUMPERS (continuing). At a cost higher than they could have gotten the same thing from foreign competition.

Mr. KOONTZ. Yes. You are talking about defense industry, and the one sector that is strong in this country at the present moment, and is the buying equipment.

Senator BUMPERS. Is that the reason they bought American, because it was defense-oriented?

Mr. KOONTZ. No, because of the conceived value and the technology that was available in the machines in the United States was much greater than it was in the foreign countries, even though the cost may have been slightly higher.

And these new manufacturing systems that were bought by these defense organizations was new, innovative, and state-of-the-art, worldclass systems that they could not necessarily buy or would not want to in the long term for serviceability and all the other factors we buy.

But——

Senator BUMPERS. Why is that an isolated case? I mean, that is very gratifying to me. Do not misunderstand me. I am very pleased to see things like that.

Mr. KOONTZ. It is to me, also.

Senator BUMPERS. But my question is why, in light of that, are 49 percent of all the tools of the kinds of equipment and machinery that you are involved in being imported?

Mr. KOONTZ. Well, primarily it was originally on price, and at the time that they made their inroads during the 1979, 1980 period when backlogs were very high, that is unfortunate to our industry. I like to say it the way it is. We were proud of backlogs. We should not have been. They made their inroads with low costs during a high dollar or whichever way you want to say it, when the dollar was high, 260 to the yen. They found out that the cost in general and the Japanese were servicing some of those early machines very well. They made their inroads, and they have stayed in the market and the cost has been lower ever since.

And then there is a preconceived notion that there is a higher quality. I doubt that, but they have beat us on cost. They have beat us on delivery and other factors. Certainly the dollar/yen relationship is going to change some of that, but to answer your first question——

Senator BUMPERS. Do you see any signs that the decline of the dollar is changing that?

Mr. KOONTZ. Yes, it has, in fact. In my own instance I acquired a company that was absolutely dead and moved it to Keene, NH, and I have 120 people working in the last year building machinery primarily that is directly competitive with the Japanese. The product is a profile miller for aerospace and tool and die shops. I undertook the strategy on the basis that things were changing, as well as the VRAs, which are the voluntary restraint rules. Those changes are very definitely the reason we put 120 people back to work.

And so those do work. But the other answer, the defense industry is strong, but the defense industry alone does not make a commercial manufacturing sector by any means. And we are also in danger of defense money being cut. And so we need the commercial sector to become strong to offset the Defense Department problems or whatever they might be financially.

Senator BUMPERS. Thank you, Senator.

Senator KERRY. Just if I could finish up quickly, we have had a lot of recommendations coming out of here about to invigorate small business in these arenas that we are talking about today, ranging from engineering resource centers, National Science Foundation grants, different fellowship programs, and so forth, ranging from the micro to the macro, obviously, would you just quickly give me your sense, if you were going to tell us one, two, three in prioritization, steps that we ought to be taking that is really going to have an impact? What are they?

Mr. KOONTZ. On the overall?

Senator KERRY. Overall impact.

Mr. **Koontz**. Overall. I am torn between the first two, and that is capital formation and a national platform, one of those two is one. I would say that we need a national platform that says that we are going to become a major manufacturing base competitor. I would ask you to adopt something similar to John Young's Industrial Competitive Commission.

Second, capital formation, and then support cooperative research ventures. I do not think you were in the room, Senator, when I referred a little bit to the National Center for Manufacturing Sciences which you have, as an administration, been highly supportive of, and have given us $15 million to get started.

Third and fourth, and I am not sure whether they are third or fourth, is to get on with this educational issue of supporting the vocational schools and re-educating the people, and I do not mean just by Government support, but sometimes there are vocational schools that are also inbred, where the same students are now teaching.

We need industry support in putting the best executives, the $100,000 executives on a part time basis to help in the education of these young people in order to get on with it.

And so I am not just talking about Government alone. We need industry to support on a matching fund basis, and we need their talent to teach on a part-time basis.

So education in general. And the national platform will also encourage engineers, American engineers to get back into the universities. And as I said before, 60 percent of our university labs that are doing our key research—and this is a well proven fact. I can get the facts—60 percent of them are foreign nationals going home to compete against us. Even in many cases the instructors are foreign. One of them from a major university in the Boston area is now the general manager of the Korean Hyundai, not Hyundai but the other one, Daewoo.

I cannot say too much. He is a major customer of mine at the moment, but that is beside the point. The fact is we have a long-range problem in those areas, and so those are my priorities.

Senator **Levin**. Did you want to comment on that?

Mr. **Mittelstadt**. Yes. I have a couple of comments.

As you suggested, there are no one-sentence answers to any of this, of course, and there is a broad variety of kinds of things that I think do need some attention.

My own prioritization would be more in the area of that education thing, and that is not just technology. It also addresses the point you spoke of, Senator Kerry, about the management of that technology. And that is, I think, what the promulgation of the success stories of small businesses and large ones in terms of adopting automation can do.

We can begin to get some of that. There is a momentum going already that we see, not only in terms of the suppliers of automation, to try to do some of the things that you talked about and that have been suggested in the testimony, but also on the part of the customer.

What we are really talking about, I think, is a matter of are we going fast enough and are there some things that we can effectively do together, industry and Government, to accelerate that movement, to keep it from getting to be a situation where many small businesses are in the same situation as some of our larger businesses where they are no longer competitive.

And I think there are some ways, perhaps, with existing programs, maybe management of those, maybe better understanding of those, without significant additional funding, for example, to be able to do some of the things we are talking about.

I think one of the speakers on the previous panel mentioned some of the innovative approaches, a parallel to an agricultural situation some years ago wherein maybe we can use some of that kind of combination of a little bit of Government funding, a little bit of industry cooperation in order to have some of the things gotten across to those many customers who we really need to get the automation to. And that is the question.

I think that adoption of a national platform is almost of equal kind of significance, and it addresses not only the issues talked about here but in the previous panel about the fact that manufacturing has not been a neat, desirable kind of area to go into in this country. I spoke at one of the major business schools not too long ago, and the faculty's purpose in having me speak was all our guys want to go into finance. They do not want to have anything to do with manufacturing.

So I think perhaps if we made that a little more of a national awareness, if you will—maybe it does not involve very much money, but more of a national awareness that that is a problem, that we can then create the feeling among college people that, hey, there is something important there to be done, there is a shortage of people, boy, that sounds like something I might want to get into, that kind of thing might well be appropriate.

Senator **Kerry**. Well, I am delighted to hear those comments.

I might just make one comment before I have to leave, and that is, as I listen to you, I hear a massive agenda, some of which can be achieved without revenue, but most of which is going to require some expenditure, most of which requires an intelligent investment of current resources for future enormous return of larger resources, and what is clear from each of the testimonies here or previously submitted as well as from all of the knowledge we have gained about this problem over a period of time is that this country is not gradually but rapidly falling dangerously behind in our ability to compete, and yet a mood has been created out there where it has been made nearly politically impossible for the Congress to be responsible and for anybody to talk about revenue.

I do not know if you saw the debate last night. There were not many people willing to say we need revenue. And as CEOs and members of the business community, I hope you are going to help to change that atmosphere because it is really handicapping this country. And if you do not join in that effort to change it, I have the sneaking suspicion that human nature is not going to see the Congress spontaneously stand up and do it.

Mr. **Mittelstadt**. I appreciate that challenge.

Senator **Levin**. There is another reluctance that I have noticed, and that has to do with just the reluctance to get Government involved in a solution. We have created some problems, but we have also provided some solutions over the decades, and I think there is just a general reluctance on the part of business to come to Congress and say this is what we need because of the instinct to be self-reliant and to get along without Government. And so there is some suspicion and some reluctance and sometimes hostility on the part of business and industry, manufacturing, small business, large business, it makes no difference. It is kind of inbred into all of us.

And the other side of the coin is that I think Government has failed to offer its hand in a really cooperative way to industry, and again, we went into last year's tax bill, as an example, without rehashing the whole tax bill, I felt privately that there was a lot of opposition to that tax bill on the part of business and on the part of industry, small business provisions of that tax bill which made us less competitive, and again, without rearguing the merits of that bill, the point is that I did not feel that reluctance publicly. I only felt it privately. I never saw it transmitted to us, for lots of reasons.

But nonetheless, it was not transmitted. And so we ended up with a tax bill which I believe many, many people in business felt will make us less competitive, less likely to form capital, less likely to save, less likely to be competitive, elimination of investment tax credit, elimination or the worsening of some depreciation allowances.

We went exactly the opposite direction, it seemed to me, but more important, it seemed to many of our businesspeople last year that we should be going in the area of competitiveness, but we did not feel that as a Congress.

Mr. Koontz—I will call you Jim because I know you well enough—you indicated that, well, you sort of said last year, OK, it looks like it is done, so we are not going to be able to do anything really on this. Let's come back next year. Let's go at them next year with what we need.

Has that happened this year?

Mr. KOONTZ. Other than having opportunities such as this to bring the point up, we will have other opportunities and I will continue, and I am sure the business leaders will continue to try to reinstate it.

Senator LEVIN. Let me just say I know we would welcome small business, big business, industry, manufacturing, we would welcome your coming to us and saying this is how we want to be more competitive. This is what we want you—sometimes it involves money, but actually there is a lot of this that does not involve money. A lot of this involves the cultural atmosphere, a mindset, a leadership, and as both of you put number one, a leadership issue which does not involve money, having to do with adoption, promulgation of the Young Commission on competitiveness, and just setting an example, for instance, in terms of manufacturing being desirable and having our leaders go out and symbolize something in terms of what we need people to get involved with.

And it is clean, it is necessary, it is essential to our economic and our physical security as a country. Just having us go out and do something symbolically is at the top of a number of lists. That does not cost anything. That is just focusing on something.

So let me see if my colleague has anything more.

Senator BUMPERS. I just have two comments. One is an observation. I agree with you on the Export Control Act. Conceivably a personal computer intended for export, if it is superior to the ones the Japanese make, could be said to endanger our nation security. But the truth of the matter is that the Soviet Union and China both are buying billions of dollars worth of high-tech goods from Japan, Germany, and Italy. We are simply losing the business to them because we are sitting here standing on ceremony.

Of course, there are items that ought to be on the export control list, but the list is much too broad. The export control list includes mundane items that can be bought off-the-shelf from any of the western nations or Japan. We are just shooting ourselves in the foot by limiting exports to such an extent.

The other point I wanted to raise is a more mundane question, and that is, generally speaking, what is the price differential between American and foreign competition on machine tools?

Mr. KOONTZ. Well, it has been certainly with the exchange——

Senator BUMPERS. Are we talking about 10 percent, 15 percent? What is it?

Mr. KOONTZ. Well, it has been as high as 30 or 40 percent when the yen was at 260. Now, the fact that it is at 132 or whatever it is, the court is still out on what the difference is, but it is probably down closer to 10 or 15 percent now. Much of their inventory is still in the country being sold at lower prices, but eventually there will become parity in certain machines, probably within the next 6 months.

I will say that the Japanese or the Europeans, whoever they might be in this market, and I am not just talking machine tools but in any commodity they are selling, are going to be very reluctant to lose this market, as it is the largest market in the world, and I am sure with some of their Government subsidies and other incentives, they will hang on for a long period of time before giving this market up, even at major losses.

Hence, I do not expect the fact that we are going to suddenly be 10 or 15 percent to the advantage by any means, anytime soon or ever. And the fear of inflation, I think it is just the other way around. I think our fear is recession. I do not see any price increases. These people are going to hang on to this market as long as they can, at any price.

I have seen Chinese machines come in to California the other day on a giveaway price. What was the price? They said $120,000, and I am just using an example, it was about that, anyway, about half the price of the American machine.

They said if you do not like it in 3 years, ship it back. They are just attempting to get the market. It is a copy of a Japanese machine. This is going to continue to go on.

We have got to learn to live with that situation, you know, in the long term.

So it is hard to say what the price differential is, but generally right now it is 10 or 15 percent, was 40. It will be anywhere if they want this market. It is the largest market in the world.

Senator BUMPERS. Is the Japanese share increasing right now?

Mr. KOONTZ. No. The overall market for capital goods is down, and so, therefore, we see figures that look good, and if the imports are down, well, obviously they are down, but they are down in comparison to American production as well because the overall economy is down.

I think we are expecting this year about $1.8 billion of machine tool shipments with American capacity of $5 billion, $6 billion, $7 billion. It is hard to tell anymore, but lots of billions of dollars.

Senator BUMPERS. What share of your business is U.S. exports?

Mr. KOONTZ. Well, surprisingly, in order to survive, I export about 25, 28 percent of my business out of the United States, but over 50 percent of my revenues come from outside the United States. I operate in Canada and in Europe, and I depend really on the international market because of the domestic market not being as good.

Senator BUMPERS. Who is your biggest competitor, Japan?

Mr. KOONTZ. No. I am in the special machine—well, it is in certain product lines. You would have to define product lines. In the profile mills, it is Japan. I am a direct competitor with Japan, but I have only been in that business 1½ years. I bought another company in New Jersey and put 120 people to work. In this special machine business Japan is not a major competitor because they like commodities and like to sell volume, and we sell engineered products basically to the auto industries of the world, the appliance industries of the world. Our competitors are more Italian, German, English, depending upon where we are. If we are in Japan, it is Japan. They do make some specials for their own market.

Senator BUMPERS. Are the Swedes in that?

Mr. KOONTZ. Not in that particular segment of the business. They are when it comes to standard NC, machining centers and/or lathes which are used by the defense industry and small tool and die shops, or presses.

Senator BUMPERS. Thank you, Mr. Chairman.

Mr. MITTELSTADT. Just a quick comment.

I think the culture is changing on the business side as well as the political side, and maybe there is some further ground there to at this point address some of the points that you were talking of, Senator Levin, in terms of the cooperative approach between Government and industry in terms of how we can get out some of these issues and some of this leadership, doing it without necessarily as much funding as we might want to have. But we recognize Senator Kerry's challenge as well.

Senator LEVIN. Mr. Mittelstadt, Mr. Koontz, thank you both for your very helpful testimony.

And we will now move to our third panel, which will give us a view of small firm users of automation technologies: Richard Buerk, who is the vice president of Buerk Tool & Machine Corp. of Buffalo, NY; Mary Conran, who is the president and the CEO of Warren Industries of Philadelphia; and Jerald Stokes, who is a partner in Arkansas Technologies, Inc. of Clarksville, AR.

Senator BUMPERS. Jerry, I am going to have to leave before you finish, and I just wanted the chance to welcome you.

[The prepared statement of Senator Bumpers follows:]

Statement by Senator Dale Bumpers
Senate Small Business Committee
Subcommittee on Innovation, Technology and Productivity

I would like to begin by thanking Senator Levin for holding this hearing and to express my regrets that Dr. Eugene Merchant couldn't be here today. Dr. Merchant's absence is regrettable, and I appreciate Dr. Richard Kegg appearing on his behalf, especially on such short notice.

The status of small business manufacturing technology and automation is an often overlooked aspect of our overall industrial competitiveness. The fact that over 70% of the total investment in industrial automation has occurred within only 1% of the total U.S. industrial base is disturbing. The need for a more widespread use of advanced manufacturing technology is becoming more and more a necessity in today's globalized markets. This is particularly true for small business, which has traditionally been the most innovative, as well as the most vulnerable, to overseas competition.

For a company to be competitive, it needs to be flexible. It must be able to limit its overhead costs, and it must produce goods efficiently and quickly, while maintaining its quality. This is not easy. Although technology in and of itself is not sufficient, many firms will find that the wise application of advanced manufacturing technology will allow them to maintain a high level of quality while reducing lead times and costs. This is not simply the reduction in labor costs either. This is the elimination of defective and quality-related costs which can average 25 to 35% of manufacturing costs.

The technology for improved production and flexibility exists. The problem lies in the fact that it just is not being implemented. Too much of our attention in this field has been on research and innovation. While this is important, it is imperative that we do not continue to overlook the really serious problem of implementation and application. The fact that not a single VCR is domestically produced anymore illustrates the problem that American industry will face if it does not capitalize on existing innovations.

There are a number of programs, both at the state and federal level, that are aimed at transferrring existing technology to the shop floor. The Arkansas Science and Technology Authority, for example, has done a great deal in helping to develop Arkansas's industrial infrastructure. There are also financing programs available through the Small Business Administration that are underutilized. The SBIC network and the Section 504 Certified Development Companies can play a vital role in providing long-term financing for new plants and equipment. These alone, however, are not nearly enough to solve the problems raised here today.

The barriers to the adoption of automation technology are numerous. These include the attitudes of management, the availability of capital, and the lack of technical expertise and education. Today's witnesses will elaborate on these and other points. However, the federal role in any of these areas is limited. The immediate problem is education and awareness. I feel that this hearing and the next will help raise the consciousness of American manufacturers to the threat of obsolesence. The role of small business is integral in maintaining the quality of the American industrial base and I support Senator Levin's efforts in identifying the problems that small businesses face in automating. This is the first step in developing a more productive small business sector.

I feel we have an outstanding group of individuals testifying before the Committee today. As I mentioned before, I appreciate Dr. Kegg's apearance on such short notice. I would also like to acknowledge Mr. Jerald Stokes of Arkansas Technologies, Inc. of Clarksville, Arkansas. I am familiar with his background in this field and am pleased that he could be here today. Dr. Jakumar, Mr. Middlestadt, Mr. Buerke, Ms. Conran and Mr. Koontz are all outstanding figures in this field and we are fortunate to have their views on this most pressing issue.

Senator **Levin**. Mr. Buerk, why do we not start with you.

Why do we not start with Mr. Stokes because I know that Senator Bumpers has to leave.

STATEMENT OF JERALD D. STOKES, PARTNER, ARKANSAS TECHNOLOGIES, INC., CLARKSVILLE, AR

Mr. **Stokes**. Thank you very much. It is a pleasure to be here, and I appreciate the opportunity of being invited to come here and share with you thoughts and ideas about some of the problems with automation in small business manufacturing.

As we are prepare to make our assessments of the problems and opportunities facing small business in automating their manufacturing processes. I think it would be very worthwhile in my testimony to first briefly review the overall need for innovation and capital expenditure in the general manufacturing sector of the economy, summarize some of the overall macroeconomic forces that are present on small business manufacturing, and then review some of the current technologies that are applicable to small business manufacturing environment, and then address some of the problems and the opportunities, as I see them, in implementing automation technologies in a small business manufacturing operation.

In summarizing the written statement that has been submitted, first of all, I address the overall need for innovation and capital expenditure. A lot has already been mentioned about this this morning. I developed a point that productivity changes, both absolute and relative, are primarily generated through a combination of technological innovation and capital expenditure, and that this is a basis for economic growth in any nation. And this is something that has been stressed by Mr. Solow, the recent recipient of the Nobel Prize in economics, a man from MIT.

I further went on to discuss some of the effects and causes of past investment deferrals in the United States, and I pointed out that the average American factory contains considerably obsolete equipment while newer businesses, however, have more often made investments in current technology because these newer businesses have not been burdened with obsolete equipment of 30 to 40 years old.

I went on to state that there is much technology that does exist today, but there is still little implemented in the workplace.

In summarizing some of the macroeconomic forces behind the need for expanded use of capital equipment in this country, I summarize them as follows: One, the need for productivity improvement, the relative gap in U.S. capital formations versus other industrial countries, inexpensive Third World labor, improvements and emphasis placed by foreign governments on technology improvements, continually decreasing product and design life cycles, the effects of short-term management incentives, contraction and aging of manufacturing facilities and equipment, the explosion of semiconductor and computer technology, and the shift in manufacturing emphasis from mechanical to electronic, and the continually expanding costs of retooling.

Senator **Levin**. What was the last word?

Mr. **Stokes**. Retooling.

I concluded that discussion with the statement that the rapid changes in demands of the global marketplace will not be able to be met without the incorporation of advanced technologies.

Then I went on to review some of the current automation technologies that are available for the manufacturing environment. I do not want to be too much like giving you a lesson here, but I want to just summarize some of the things that are available today. We have such things as computer-aided design, computer-aided manufacturing, and computer-aided engineering equipment, all kinds of sensing systems, optical, acoustical, tactical, automated materials handling, robotics, flexible machining centers and flexible machining systems, flexible assembly systems, flexible welding systems, automated test equipment, numerical control and direct numerical control of various machine tools, and specialized equipment and processes that utilize such technologies as lasers and waterjet cutting.

All of these technologies do have a common thread in that they utilize some form of electronic input and/or output which enables the overall control of this equipment to be accomplished with computers and software. This broad spectrum of activities is the scope of computer-integrated manufacturing.

This in turn translates into a considerable number of participants with which the small business manufacturing organization must cope with and understand.

Before going into some of the problems and opportunities, I commented generally that the small business manufacturer can range from being anything from a mom and pop shop with a few employees to a private or publicly-held firm with up to as many as 500 employees. The small business capital structure is a very important relationship to the firm's management attitude and decisionmaking regarding capital investment alternatives.

In the summary of the problems in implementing automation in small business manufacturing, problem number one, as I see it, is the lack of strategic planning and organization. Most small business manufacturers do not plan long-range and cannot visualize capital expenditure alternatives as a company strategy rather than a quick fix for a current problem. Many small business manufacturers do not plan beyond their current backlog or the life of their current product.

I went on to discuss an example of a midwestern manufacturer who could not see the need for developing flexible capabilities in his manufacturing and engineering operations and subsequently lost all the business to competition.

Problem number two is the lack of capital, and generally all small businesses lack capital. I did review in summarizing this problem—and I am going to talk for a moment on a regional basis now because my perspective is from the Midsouth and Southcentral region of the United States—that the regional bankers in this region are not traditionally oriented toward manufacturing. Generally they are more oriented toward agriculture and mineral extraction activities.

Venture capital in the region is practically nonexistent. There are, however, very good Federal and State programs that are already in place that are very good resources for capital for small business, but the requirements for local initiatives are difficult to meet.

The third problem is the lack of technical staff. Small business manufacturers hire the very minimum of technical staff and cannot afford the luxury, as they would say, of research, experimentation, and development. So, therefore, small business manufacturers have to adopt a "show me what works for me" or "where can I see a proven installation approach?" That is the basic approach that they take to new innovation. They depend very heavily on other people to pioneer new ideas for them, such as the suppliers of new innovative products, which we have some of them here today, or systems integrators like my company, or larger firms that manufacture similar products as they do. They rely on these three sources in general to pioneer new ideas and make developments for them.

And then I summarized this problem area by a statement of my support for the Technology Competitiveness Act of 1987, the S. 907, and particularly section 23, which talks about the development or the establishing of technology-transfer centers around the country which I think is a very good idea because this would be a way to address the "show me" approach to the small business manufacturers.

I would certainly think that manufacturers of technology products and systems integrators, would definitely support these types of centers. They would possibly donate some of their products or make available some of their products to these centers, and the systems integrators such as my company would be happy to bring clients there for demonstration and training. I think it is a very good point.

Another problem is the availability of technical human resources which has been discussed today. In my summary of this I had touched upon the causes for, and again, specific to my region of the country, the reasons that we have not developed a critical mass of technical human resources such as you find in certain higher profile technical and scientific areas of the country like Route 28 around Boston or Silicon Valley in California or Research Triangle in North Carolina, places like that.

I went on to discuss, however, what means do we have of obtaining these technical human resources in our area. Well, the best way that I know from my experience has been to home-grow it. That is to nurture people from the local human resources that have an attachment to the area. This, however, requires long-range planning and does require a commitment to the business.

Also retraining of displaced employees. I have had very positive experiences with the Job Training Partnership Act Program in Arkansas. I think it is an excellent program, and I would suggest in this area that some way, maybe a modification or some version of that program could be focused on retraining of existing employees for upgrading of jobs that are directly related to an investment in a specific area of technology, much like the midcareer training portion of that act for training people in the teaching profession.

The last problem that I addressed is justification. Of course, everyone grapples with this. Many small business manufacturers only consider the value of the anticipated direct labor reduction or elimination of direct labor as the sole basis for the amount of funds justified for implementing innovation. There are, however, many other intangible benefits that are very important, and these are such things as reduced lead time, improved quality, improved worker safety, and flexibility for the future.

These are the kinds of things that require gut management instincts, where management must apply some value to these areas, and this is where management attitude in the business is very important.

In the area of justification, I talked about tax incentives. I do not think that tax incentives are a major factor in justifying capital expenditures for small businesses. However, this area could become a bigger factor in the justification process if certain depreciation schedules could be more in line with the applicable banking terms that you are able to get on the same equipment.

In looking at the opportunities or the advantages that I see small businesses having to implement automation, the first one, which I had mentioned earlier about capital structure, is that small businesses with family, private or closely-held capital formations, or new small public ventures are more conducive to allowing long-range management attitudes. And I went on in my statement to give an example of the U.S. clay brick manufacturing industry in which many small business manufacturers adopted a long-range management attitude, which resulted in the industry today producing more brick than 20 years ago with five times as many plants.

There was also some discussion here earlier today about some of the things going on in Italy. My experience from managing a company in Italy for 3 years which was a joint venture where we had a 50/50 partnership, was that the Italians' attitude toward investment and capital expenditure was very clear. They consider it a business crime if you are not putting at least, at the very minimum, your depreciation, back into the business, and from time-to-time they would get very upset with their American partners because we did not always look at things that way.

The other advantages I see is small businesses are generally labor-intensive operations. The opportunity here is not so much to eliminate the labor or to reduce it, but to reorganize labor and support it with technology whereby developing what Mr. Jaikumar, in one of his writings calls intelligent assets. Any business that has a long-range attitude and is developing intelligent assets is better prepared for future changes in the business.

The other advantage I see in small business is the closeness to the customer. Small business is very close to the customer, they can better understand customer needs and anticipated changes and the impact which that has on its own business.

And last in the areas of opportunities is I think that small businesses are generally organizationally fast and flexible, and thereby they have the opportunity to participate in networks that can improve and expand their products and services.

So, in closing, I would like to summarize my comments around the three issues that were to be addressed. In my comments on problems and opportunities, I outlined five main barriers to automation in small business manufacturing firms and discussed specifically in the justification problem the basic lack of understanding of expected benefits and cost aspects of automation by small firms.

In my comments about strategic planning, capital structure, long-range management attitudes and human resource development, I have tried to develop a profile of what kind of firms are good at managing automation.

I am impressed with many of the existing Federal and State government initiatives to assist small business. I hope that my comments supporting the Technology Competitiveness Act and suggestions about the Jobs Partnership Training Act and tax incentives will be helpful in focusing these initiatives more specifically at the adoption of automation technology and small manufacturing firms.

And, of course, I would like to thank you leaders of our Government for having this hearing and showing your interest in this subject which is so vitally important to the future of small business manufacturing in the United States.

[The prepared statement of Mr. Stokes follows:]

Statement of Testimony

by

Jerald D. Stokes

for

The Subcommittee on Innovation, Technology,
and Productivity of the
Senate Small Business Committee

at the hearing on

Automation in Small Business Manufacturing

held

December 2, 1987

at

The Russell Senate Office Building
Washington, DC

Automation in Small Business Manufacturing

As we prepare to make our assessments of the problems and opportunities facing small business in automating their manufacturing processes, I think it would be worthwhile in my testimony to first review briefly the overall need for innovation and capital expenditure in the general manufacturing sector of the economy, summarize the overall macroeconomic forces that are present on small business manufacturing, and review some of the current automation technologies that are being applied in the manufacturing environment today. Following this review I will try to address the problems and opportunities, as I see them, for implementing automation technologies in small business manufacturing operations.

The evolution of man through his various Ages (Bronze, Iron, Power, etc) is well documented as is the associated rise of productivity with various stages of substitution of mechanical or powered devices for manual labor.

It is further well known as to how the recent past has shown deterioration of the rates of productivity gains (and sometimes even declines) as well as the creation of substantial differential rates between the United States and other industrial nations (such as Japan, West Germany and others). While societal, cultural and psychological implications for these change are often cited, it is thought by many that productivity changes, both absolute and relative, are primarily generated through a combination of technological innovation and capital expenditures.

This is a basis for economic development as has been stressed for many years by Mr. Solow of MIT, the recent recipient of the Nobel Prize in economics.

Coupled with productivity problems is the well known issue of the relative amounts of capital plant and equipment spending in the U.S. vis-a-vis Japan, Germany and others. Both of these countries have, after rising from the ashes, poured enormous amounts of money into modern fixed assets with substantial focus on generating state of the art manufacturing facilities, properly equipped to be low cost efficient producers, and thus have developed certain industries to be more than cost competitive with aging and unrejuvenated U.S. bastions of manufacturing capability. Such events have helped accelerate the loss of entire industries, once the exclusive province of U.S. companies (such as stereo) and the loss of significant portions of other industries (such as automobiles, cameras and television).

U.S. companies have had an inherent problem of capital investment deferrals, as primary management motivation has been often short term in nature which when coupled with the transiency of positions in U.S. industry, does not create the incentives needed for decisions whose benefits will not be fully measurable until the longer term.

The average American factory contains considerable technologically obsolete equipment and processes. The 30 or 40 year old machines that were enormously beneficial when introduced are often still employed even through quantum leaps in technology have occurred and this equipment was fully depreciated many years ago.

The newer businesses in the U.S., not burdened by such equipment, have more often made the investments in current technology.

Much technology exists today to work more intelligently, but little of it is yet implemented in the work place. Factory automation, in all its many aspects, can provide the needed capabilities for the U.S. to continue its leading manufacturing position and much of this must happen at an increasingly rapid rate over the next several decades.

In summary the following are some of the macroeconomic forces behind the need for expanded use of capital equipment. These include:

- The need for productivity improvement.
- The relative gap in U.S. capital formation versus other industrial countries.
- Inexpensive third world labor.
- Improvements and emphasis placed by foreign governments on technology improvements.
- Continually decreasing product and design life cycles.
- The effects of short term management incentives.
- Contraction and aging of manufacturing facilities and equipment.
- The explosion of semi-conductor and computer technology and the shift in manufacturing emphasis from mechanical to electronic.
- The continually expanding costs of retooling.

World competition has accelerated substantially in the past few decades. American manufacturers, to survive, must incorporate advanced automation into their production processes.

The changing nature of the market place, the rapid proliferation of new products and consumers' increasing demands for improved quality will only be satisfied by the production of high quality cost effective goods along with the ability to convert production to the rapid changes in the marketplace. These goals will not be met without incorporation of advanced technologies.

The following table shows the major components of factory automation technologies as they apply to general factory activities.

The Factory	Factory Automation Technologies	Overall Control
R & D Engineering	CAD/CAM/CAE Short Run Automation	Computers Software LAN Control Systems
Material Receipt	Vision Sensing ATE	
Discrete Parts Mfrg	Specialized Equipment NC DNC FMS	
Storage	Material Handling Systems Robotics	
Transport To Assembly		
Assembly	NC DNC Robotics Sensing Systems FAS Material Handling Systems Specialized Equipment	
Test-Repair	ATE	
Package	Robotics Specialized Equipment	
Storage	Material Handling Systems	
Ship		

The overall scope of activities as shown in the above table can be defined as Computer Integrated Manufacturing (CIM).

We can see that CIM encompasses a very broad spectrum of activities which in turn translate into a considerable number of participants with which the factory organization must cope with and understand.

A small business manufacturing operation can vary in type and size from a "mom and pop" proprietorship with several people to a private or public held corporation having as many as 500 employees. A key element in the implementation of automation technology in small business manufacturing is the capital structure of the small business firm. Capital formations are created to carry out some specific economic strategy or plan. The business strategy or plan may be something as simple as generating enough net profit to provide an adequate living for a family to well articulated plans for market penetration, expansion and continued growth in sales and earnings. The capital structure of the small business manufacturing operation has a very definite relationship with management attitude and decision making regarding capital investment alternatives. This is a point I will refer to and develop further as the problems and opportunities for small business manufacturers are discussed in detail.

I would like to begin this part of my testimony by identifying some of the problems or barriers in implementing automation technologies in small business manufacturing.

Problem No. 1 - Lack of Strategic Planning and Organization

Many small business manufacturing firms do not have any goals that extend beyond the life of their current product line or order backlog. The management of such operations are generally heavily involved with day-to-day production and quality problems. Managers in this situation have difficulty in visualizing capital expenditure alternatives as a company strategy rather than as a quick fix for a current problem.

I am familiar with one mid-west manufacturer of mechanical power transmission components that had initially procured obsolete equipment and tooling to manufacture a high volume power transmission product line. The equipment and tooling was intended for large production runs for a small family of similar parts.

The product line was a mature product that had been sold to users by other manufacturers for some years prior to this firms entry into the market. Initial market penetration landed the new firm only orders for the specialty items, or, modified versions of their intended standard products since the customers were already well supplied by three other high volume producers of the standard products at acceptable prices. The firm booked and processed the orders which required added engineering resources and extensive set-up and tooling costs for the short run quantities.

The firm hoped that processing the special items would keep it active with the customer accounts so it could continue to try to position itself to obtain the larger volume standard product orders. Due to the difficulty in processing the short run orders with obsolete high production machinery and tooling, and, the extensive engineering changes required to the product design, the firm began to experience longer lead times on orders, poor delivery performance and quality problems. It is obvious what happened to the customers. They were lost.

The other side of this story is that a competitor (also a small business) in a neighboring state saw an opportunity to provide the market with the special products and invested in flexible machine tools and computer-aided-design equipment. That firm totally captured the market for these higher priced, higher profit margin non-standard products. The loser in this case wanted to process the special items but lacked the capability to evaluate its engineering and manufacturing resources as part of the marketing strategy.

Problem No. 2 - Lack of Capital

Small business manufacturers in general lack capital, particularly for strategic purposes. The availability of private sources of capital for small business varies in different regions of the country. In the mid-south and south central regions of the U.S. private capital resources are traditionally oriented toward agriculture and mineral extraction activities. Venture capital in this region is practically non existent.

A high percentage of the manufacturing operations in this region are subsidiaries or divisions of companies not based or headquartered in the region. The financial needs of these operations are mostly fulfilled by banking institutions outside the region. Therefore, the regional bankers, particularly in the small towns, which would have the most familiarity with local small manufacturers needs are either limited in the amount they can loan or not able to accommodate equipment loans on manufacturing equipment that may require note liquidation over periods longer than 3-5 years. Additionally, few are even willing to work credit lines for manufacturing working capital that are collateralized by anything other than property, plant and equipment.

Capital is available to small business manufacturers through various federal and state programs. The Economic Development Administration (EDA) of the federal government administers Small Business Administration and EDA Revolving Loans through a well established network of district offices in each state.

Although the revolving loans present the best opportunity for equipment capital for small business, they still require matching funds from some local lending source that is willing to loan the money at the same rates and terms as the EDA which are very favorable to industry development. Most local lending sources (banks particularly) do not want to lend money under those terms.

Most states have some form of industrial or economic development agency which also have both state and federal funds available to small business for purposes of job creation. These funds generally are available for plant and equipment expenditures and are available at very good terms. Much like the EDA revolving loans, however, these loans generally require other participation on at least a two to one basis.

Some states also may have other capital formations which focus on specific areas of development within the state. Such an example is the Arkansas Science and Technology Authority (ASTA). This organization has several programs that range from institutional research and development grants to seed capital loans for new businesses in science and technology. Organizations of this type may vary from state to state but it would be my opinion that available funds from such organizations for implementing automation in an existing small business manufacturing operation would be limited, or at least very competitive to obtain. In any case obtaining funds from all of the forementioned federal and state sources of capital requires a well articulated and documented business plan which brings problem number one as already discussed, back into focus.

Problem No. 3 - Lack of Technical Staff

For the most part, small business manufacturers employ the very minimum of technical staff. The small manufacturing organization is generally focused on the operational problems as related to personnel, material acquisition and delivery schedules.

The small manufacturer may be aware of new processes, materials, techniques or technologies that may improve his product or make him more productive, but, he cannot effort the luxury of research, experimentation and development. Therefore, their approach to innovation or implementation of new ideas is usually that of "show-me-what-can-work-for-me" and "where-can-I-see-a-proven-installation?".

Small manufacturers look to the suppliers of new innovative products, systems integrators, trade associations or larger manufacturers of similar products to pioneer new ideas that may be readily available for their use at some future time. Some states, such as Arkansas, have implemented technology transfer programs through the state funded university systems. This approach has had only moderate success since the technical expertise offered by academia is either that of totally inexperienced, although ambitious, undergraduate students or tenured professors that are totally out of touch with the realities of risk taking and the economic struggle for survival. The fact, however, that these programs do offer a pool of human resources with good minds and a willingness to learn does give the program good potential if effective facilities, program leadership and organization can be put in place.

I am very enthusiastic about the Technology Competitiveness Act of 1987 (S.907), particularly the new Section 23 which would establish centers for the transfer of manufacturing technology. Properly staffed and managed, these facilities could be the answer to the "show-me" approach of small business manufacturers. Suppliers of manufacturing technology products, and, systems integrators I think would be very supportive of such centers by offering demonstration products and equipment and bringing their small business manufacturing customers there for training and demonstration.

Problem No. 4 - Availability of Technical Human Resources

This problem area is one which may vary in different parts of the country. In the mid-south, south central region the number of engineering and technical graduates is well below the national average.

Many of the engineering and technical graduates in the region also leave the area seeking better paying opportunities in other parts of the country. These factors coupled with the relatively low number of high technology operations in the region have not enabled a development or growth of a critical mass of technical human resources as is found in such high profile technical and scientific areas of the country like Silicon Valley, in northern California, Route 128 near Boston and Research Triangle, North Carolina.

The best source of obtaining these valuable human resources in this region, from my experience, has been to home-grow it. That is, for the small business manufacturer to create, nurture and develop, from within the company, the needed technical skills from local human resources that already have strong attachments and desires to stay in the geographic region. This is sometimes a long and tedious approach and it requires long range planning and commitment to the business. The pay-off however, is reduced turnover in personnel and company loyalty. Another avenue of obtaining needed human resources is to develop displaced employees from other operations in the area that have either cut back, closed or relocated operations. Many of these employees may desire to stay in the area for personal reasons.

These people make very good candidates for retraining. I have had excellent results in working with the federally sponsored Jobs Training Partnership Act (JTPA) program in Arkansas. The administrative contractors are well dispersed and very close to the training organizations.

With this very close contact between the program administration and the training organizations, or firms, it would seem to me that some modified version of JTPA could be developed to serve as an incentive for small business manufacturers to invest in specific automation technologies. This could involve some sort of program assistance to upgrade or retrain existing employees into a higher paying job that is a direct result of some capital expenditure in a specific area of manufacturing technology. This could be similar to the part of JTPA that retrains mid-career people for the teaching profession.

Problem No. 5 - Justification

This is always the problem that surfaces first when a small business manufacturer is considering capital expenditure of any kind.

I have listed this problem fifth because I feel that often this problem is a symptom of the other four problems already talked about. A lot has been said and written about the obsolescence of some accounting practices and principles regarding justification for automation capital expenditures. The process of justification requires quantification and the most readily measurable factors effected by change in manufacturing processes are material and direct labor. In durable goods manufacturing the material content in the product is primarily controlled by the product design. Opportunities for applications of manufacturing automation technologies to reduce material costs are limited to the areas of reducing scrap losses and controlling the proper quantity of material when being applied to a product.

Many manufacturers, large and small, look strictly at the value of the expected reduction or elimination of direct labor as the sole basis for the amount of funds that are justified for implementating innovations. On top of this, many firms will add unrealistic payback criteria of one year or less. Many of the advantages that manufacturing automation technologies may offer a small business manufacturer are those that are intangible such as reduced lead-times, better product quality, worker safety and flexibility for the future. These are the areas where the gut instincts of management must apply some values. This is where management attitude about the business and its future are important and I think it relates directly to the capital formation of the firm itself.

Whether the stockholders are collectively building hope for the future or maximizing the present their desires will be carried out by their chosen company management. Most company managements are somewhere in between those desires and striving to satisfy both.

Many and various tax incentives have been implemented to influence capital investment. I don't think that tax incentives are a major factor in the justification of capital expenditures for small business manufacturers. I would think, however, that reducing equipment depreciation schedules to be more in line with current banking terms for such equipment would seem reasonable and could make this incentive a more significant factor in the justification process.

Now I would like to identify some of the opportunities, or advantages, that small business manufacturers have to implement automation technologies in their processes.

Opportunity No. 1 - Small Business Capital Structure

The opportunity as I see it here is the likelihood that existing small business manufacturers having a family, private or closely held capital formation, or, new small public ventures, would be more conducive to allowing longer range management attitudes toward implementation of innovation and capital expenditures. Such management would be inclined to build intelligent assets by employing a combination of training human resources and implementing capital investment such that long range plans and strategies for growth and the perpetuation of the business can be achieved.

A good example of this can be found in the U.S. clay brick industry. The clay brick industry is a very old industry which was about 20 years ago made up of some 1,500 small business brick manufacturers spread around the country. These "brick yards", as they were called, were mostly family or privately owned operations. These brick plants were very labor intensive as vast quantities of material had to be handled in order to prepare the clay, form the bricks, stack the brick in the kilns for firing, then unload the brick for delivery to a distributor, or, to a job site.

Many owners of these brick manufacturing operations had very high confidence in the value of their product as a construction material and realized that there could always be a future for their products as long as they were competitive with other alternative building materials. Many of these owners readily adopted a long range approach that had one simple strategy; reduce the unit costs to produce brick and stay in the business.

I have had, along with some of my colleagues, the opportunity to work with this industry for many years as many far sighted manufacturers set about automating their brick manufacturing operations. Over a period of 20 years many have transformed their operations from labor intensive batch operations to a continuous process with computer controlled kilns and automated materials handling and packaging.

This is the only industry that I have observed that actually carried out aggressive capital investment implementations at the most appropriate time... when business was slow.

It was a difficult task for many of these innovators. They not only pioneered new technologies into there processes but they also had to transform their human resources along the way.

The overall result is that today the industry is made up of less than 300 plants which can produce more brick than the industry did with five times as many plants 20 years ago. As this industry consolidation took place the successful implementors of innovation not only survived but have become world-class brick producers and are now very attractive acquisition candidates for larger public firms with adequate capital for assuring continued growth.

Opportunity No. 2 - Labor Intensive Operations

Many small business manufacturers are generally labor intensive operations. The opportunity here is not necessarily to eliminate or reduce the labor content, but rather to reorganize labor and support it with innovation, training, and capital expenditure thereby transforming labor into intelligent assets.

A small business manufacturer that has a long range management attitude and is building intelligent assets is better prepared for rapidly changing market conditions.

Opportunity No. 3 - Closeness To The Customer

Quite a number of books have been written in the past several years about business competence, cultural waves and trends and organizational excellence. Somewhere in all of that was a statement that said that the successful manufacturing companies of the next two decades will be those that can bring technological innovation closer to their markets.

Small business manufacturers are very close to their customers. This close relationship gives the small manufacturer the opportunity better understand the customers needs and anticipated changes. The small manufacturer can better assess what areas of improvement in his own business could help him better serve his customer.

The concept that small business can move innovation quicker to commercialization has been positively evidenced by the successful Small Business Innovation Research (SBIR) program started by the federal government in the early 1980s.

Opportunity No. 4 - Networking

Small business manufacturing organizations are fast and flexible. This characteristic gives them the opportunities to participate in business network arrangements both horizontally and vertically. Small business manufacturers can implement technologies which can enhance their ability to link up with customers and suppliers to form more efficient vertical chains of service and delivery. They can also participate in horizontal networks with other compatible manufacturers to form networks that can offer new and expanded products and services.

In closing this testimony I would like to summarize my comments around the three issues that were to be addressed. In my comments on problems and opportunities I outlined five main barriers to automation in small business manufacturing firms and discussed specifically in the justification problem the basic lack of understanding of expected benefits and cost aspects of automation by small firms.

In my comments about strategic planning, capital structure, long range management attitudes, and human resource development, I have tried to develop a profile of what kind of firms are good at managing automation.

I am impressed with many of the existing federal and state government initiatives to assist small business. I hope that my comments supporting the Technology Competitiveness Act and suggestions about the Jobs Partnership Training Act and tax incentives will be helpful in focusing these initiatives more specifically at the adoption of automation technology in small manufacturing firms.

I would like to thank you, leaders of our government, for having this hearing and showing your interest in this subject which is so vitally important to the future of small business manufacturing in the United States.

Senator **BUMPERS** [presiding]. Thank you, Jerry.
Mr. Buerk.

STATEMENT OF RICHARD K. BUERK, VICE PRESIDENT, BUERK TOOL & MACHINE CORP., BUFFALO, NY, ACCOMPANIED BY BRUCE HAHN, NATIONAL TOOLING AND MACHINING ASSOCIATION

Mr. **BUERK**. Senator.

I think I come in on a different approach. First of all, I have been a political activist in business since the late 1970s, and I have been down here on Small Business Day and have spent a lot of time in Albany where our capital is. One of the things that I have found as a small businessperson is that there are two types of small businesses. The first type of small business are those businesses that are not big yet; and there is a second type that are small because they are small, and they want to stay that way. And many of the people in the, if you want, the potential automation area that we are addressing are not those that want to become the next Boeing, LTV or IBM. They are very similar to most of the Japanese companies who are very small, and most likely less sophisticated than they are.

So I think whatever you have to do is you have to, when you make decisions, say, "What are we talking about, which group?"

Now that I have said that, I think we can refer to President Kennedy who talks about all boats, large and small, rising and falling with the same tide. And you look at small businesses, and my compatriots here, and we find that our best customers are big businesses, so that you really have a problem, I have a problem, anyway, coming here as a "special" interest. I would rather come here and have you look upon me as a "general" interest rather than a small businessperson trying to get something from the Government.

One of the things that I have seen—and I am not going to reiterate my testimony because I think it is unnecessary, and people that have preceded me have also pretty much described some of the problems that I have had or I am witnessing now. There is a premise that goes around that says that "taxes discourage and subsidies encourage," and one of the problems that you have with small business is buying, if you want, automation. But you also have that with large businesses as well.

One of the things that has happened in the last year, and evidently my voice was not heard in opposition to the Tax Reform Act, is—and I am going to talk about taxes discouraging—is the fact that we have lost the investment tax credit, the accelerated depreciations have been decelerated, and right now we are having problems, as we had problems last year and the year before and the year before that, in buying pieces of automation.

Now, I am just laying down some numbers. I am a member of an organization, which is the National Tooling and Machining Association, which I am sure you are familiar with. My fellow members, which run somewhere around 10,000 to 12,000, in 1986 made 1 percent profit, OK, 1 percent. Normally, when one makes a profit one can reinvest that money. But 1 percent profit, it is very difficult, particularly when you find that most of the members, so I have been told, are somewhere between 17 and 20 people, so we are really small businesses.

But you do not have to talk about the metal-cutting industry. You can talk about the printing industry. You can talk about people that make heat exchangers, the welding industry, whatever it happens to be. The profits pretty much across the board aren't there so that we can go, if you wish, and buy a piece of whatever automation is, however you define it.

I know that I can buy a lathe, in fact, I just bought a lathe for about $12,000 to $13,000. It was made in Brazil, and the reason it was made in Brazil is nobody in America makes a basic engine lathe anymore.

If I were to buy an automated lathe, I could probably get, depending on the quality and the configuration, and so on, I could get somewhere, somewhere between $70,000, upwards to, say, $150,000. That is quite an increment from going from $12,000 to $70,000 or $100,000 when you figure that our percentage of income is so low, our profit is so low.

So the problem is you have got to go somewhere else to acquire automation unless something can happen to make capital more available to smaller businesses or to even bigger businesses, OK?

You know, I have a customer who has a plant that I compete against in Britain, and in Britain, if I bought a—if I were in Britain, I could buy a piece of automation, which I think you would encourage me to buy and to use, I could write that off as an expense in the year I purchased it. Nobody is forcing me, such as you via the Internal Revenue Service, to write that off somewhere between 7 to 12 years. OK, I write it off all in 1 year, expense it. Expense it, be done with it. The next year I could be operating that machine, theoretically hiring more people.

But here we are frustrated by that.

Now, I talked initially about all boats, big and small. One word that I did not use in my written testimony was the word "generic." I think what we have to do is have generic solutions, solutions for everybody. We have Federal, State and local programs to encourage businesses. They come through Industrial Development Agencies. In New York State we have a Job Development Agency, statewide. We have an Urban Development Corporation statewide where if I go to them and say in the next 3 or 4 years I will hire 3 or 4 more people, 30 or 40 more people, and so on, if you can put together a package that will give me a 2 percent below prime loan, and I can get from my local taxing groups tax forgiveness for 10 years, and if I build an addition or if I have to pay a sales tax, if you can forgo that, all right, this is what happens. It happens in New York State. It happens in Michigan, it happens everywhere.

The problem with that is this, and this has happened to me. I am here—one of the reasons I said yes is I am a victim. I am not the only victim of this. There are many other victims—is that a competitor of mine, more than one, actually, but I will talk about one, did exactly this, went and got I think it is an Industrial Revenue Bond Program, and so on, 2 percent under prime; put his act together, went to one of my customers. We were both vendors to this customer. And he said, "Whatever Buerk is doing, we will do for 15 percent less." And our customer said, "Gee, that is great. OK, do it.

At the same time I had purchased—and I will tell you what it is. It is a T-10 Cincinnati Milacron computer-driven, CNC lathe with 128K computer. OK, it keeps going, it keeps going like that. And I was paying at market prices. And what happened was this other company, based on the benevolence of everybody, idled my machine with payments still to go on it.

What I think we have got to do is we have got to stop that kind of stuff because all we are doing is we are shooting each other in the foot, and because I live in a border town, I have lost business into Canada, and I know that it is difficult buying American machine tools of certain configurations because the Japanese have really done it to us in terms of turning centers and machine centers.

One of the things I think we have got to do is we have got to make capital available. Now, what I am saying to you is this: Tax me. You know, if I make a profit, I should pay a tax. I have no problem with that, and nobody in this room should have a problem with that. But it is sort of like the Fram Filter advertisement, "pay me now or pay me later." What I would like you to do is—well, what I would like me to do to you is pay you later. Let me get my automation in place, and I can say the same thing for General Electric or IBM, let us be productive, let us be profitable, and as that productivity comes in and we hire more people, we can pay more taxes and the people that we hire will also be paying taxes.

But I think the problem with the Government right now is they are trying to grab money early rather than, in a certain sense, coventuring with each individual corporation and taking profits, if you want, your share and our share, later down the stream.

I am saying it maybe a different way than everybody else does, and it is because I do not follow S. blah, blah, blah, blah in the tax code like my accountants do. I guess I am either a consumer or a payer or whatever. But what I am saying to you is if you can take a longer term view, you know, the Japanese have plans, business plans that extend out to 20 years or 50 years, and I think Mr. Stokes is right in the sense that what we are trying to do is just we are trying to shoot the snakes closest to our boots, and I do not think that is a way that anybody should run a business.

But that is the way I think in a certain sense we are forced to. And I can say this to you, and I can say this on a State level, and in many cases I can say this on a local level, we are trying to tax too quickly. Let us invest, and if you wish, conceptually invest with us, and when we are profitable, you will be profitable rather than trying to take your money up front, all right?

I, too, have a laundry list of things to do. First of all was the financing, but the second thing is my support of technical assistance centers. I have a problem with the machine tool dealers or builders in forming centers because I am hoping they can, but I am hoping they can do it without bias. You know, there are all sorts of ways to talk, to communicate, and one is to "sell," and one is to "tell," and the other is to "yell."

What I am interested in is having people "telling" me what to do rather than selling me. I want people to help me meet my needs and not have machine toolbuilders sell to meet their needs. So these technical assistance centers have got to be truly unbiased, and they really have to have, I believe—and again I am talking metal cutting, but I could be talking printing, I could be talking fabrics or shoes, whatever it happens to be, but on a very generic level.

The next thing is that you in the Government have a lot of information that you do not tell us. There are arsenals, there are shipyards, there are technical centers, Air Materiel Command is a good example of one, where you are cutting metals, you are doing this and you are doing that, and you are saying it is proprietary or we are afraid that such and such a government will make use of it. I am not too sure all that information should be classified. It can be shared, and it could be shared, again, without special interest. You know, if I had an administrative assistant, what I would do—sorry, fellows—but what I would do is I would send them out to these places and find out what could be told and what cannot be told and start to disseminate information that the Government already has.

The other ideas that I have are pretty much the same, and I know both of you are fairly agricultural in your States. You have A&M and A&I campuses there, but what you have been able to do for, I believe, 100 years in dealing with agriculture you should be able to do with manufacturing. And this is something, and I will give you a good example of a land grant college, one of the first two was MIT. The way they energize in part Route 28 and that famous story that we know about.

But we have land grant colleges throughout America, and those should be energized, and rather than spending money subsidizing individual small businesses or individual large businesses, maybe what could be done with that money is again going into a generic use, use in these technical assistance centers, whatever you want to talk about.

The other thing is more specific, and that is this. I can cut metal pretty well. I am a terrible salesman. I just do not sell. And the reason I do not——

Senator **Levin** [presiding]. You are doing real well this morning. [Laughter.]

Mr. **Buerk** [continuing]. I am just telling you the truth this morning. Talk to my customers.

One of the things that Senator D'Amato did, and I know that a number of professional associations are doing, is they are having procurement fairs and bringing together, in Senator D'Amato's case, prime contractors from—meeting, allowing them to get together in a room with small businesspeople. I could make a variation on that. Rather than sending the junior executive, as they did up in Rochester, NY, a couple years ago, to Senator D'Amato's fair, if you want to call it his, what you can do is maybe send more major players in that purchasing decision process. I think there can be some substance in those.

And the last thing, and of course, this is something that has bothered me a long time, and I think the Toshiba deal with the Russians has been one of them. The loss of steel, I sort of hopefully pulled your leg or got your attention center when I talked about, at the end of my testimony, the automobile. When we were kids we used to talk about the Big Three plus American Motors. Now I think realistically we have to talk about the Big Eleven.

There is a lot of industry that has left America, and a lot of, I think, our trading nations, and Japan is one, has not been playing to the rules. My suggestion is that maybe they should be monitored a lot closer than they have been to see if perhaps we can control some of the dumping or however you want to call it, in the American marketplace, as the world marketplace.

I am going to hang up right now.

Thank you.

[The prepared statement of Mr. Buerk follows:]

BEFORE THE
UNITED STATE SENATE
COMMITTEE ON SMALL BUSINESS'S
SUBCOMMITTEE ON INNOVATION, TECHNOLOGY, AND PRODUCTIVITY
DECEMBER 2, 1987
TESTIMONY OF
RICHARD K. BUERK
BUERK TOOL & MACHINE CORP.
BUFFALO, NEW YORK

MY NAME IS RICHARD KUMMER BUERK. I AM THE CHIEF OPERATING OFFICER OF THE BUERK TOOL & MACHINE CORP., 315 GROTE STREET, BUFFALO, NY 14207-2498. BUERK TOOL HAS BEEN OPERATING SINCE 1918.

BUERK TOOL EMPLOYS UNDER 20 PEOPLE. WE HAVE 7 MACHINE TOOLS WITH COMPUTERIZED CONTROLS. MY GRANDFATHER, THE FOUNDER, PURCHASED THE FIRST JIG-BORER, THE ULTIMATE OF PRECISION METAL REMOVERS, IN UP-STATE NEW YORK. MY FATHER WAS ONE OF THE FIRST MANUFACTURERS TO USE CARBIDE TOOLING IN THE LATE 1930'S AND ONE OF THE FIRST TO MACHINE STAINLESS STEELS IN A PRECISION ENVIRONMENT. WE PURCHASED THE FIRST NUMERICALLY-CONTROLLED MACHINING-CENTER FOR A SMALL BUSINESS IN UPSTATE NEW YORK.

WE HAVE BEEN IN SPACE SINCE 1958, BEING PART OF AN EARLY JUPITER-REDSTONE SERIES OF ROCKETS. BUERK TOOL HAS BEEN WITH EACH MANNED-FLIGHT BOTH AT TAKE-OFF, DURING FLIGHT, AND DURING THE PRECISION LANDINGS FROM SPACE. ON THE CEILING OF THE SPACE MUSEUM CLOSEST TO THE CAPITAL BUILDING, YOU WILL FIND A SURVEYOR, LUNAR-LANDER, WITH 3 GOLD-PLATED RETRO-ROCKETS, PART OF WHICH WE MADE AT BUERK TOOL. BUERK TOOL HELPED MAKE PARTS OF THE INTERNAL MECHANISMS FOR AMERICA'S FIRST HINGED-WINGED JET AIRCRAFT. IN A MORE COLORFUL WAY: MY GRANDFATHER MADE THE FIRST QUAKER-GUNS TO SHOOT PUFFED

OURS IS ONE OF BETWEEN 10,000-12,000 FIRMS IN THE U.S. MOST OF THESE ARE FAMILY-OWNED EMPLOYING ABOUT THE SAME NUMBER OF PEOPLE.

THE AUTOMATION AND OTHER STATE-OF-THE-ART TECHNOLOGIES IN THIS INDUSTRY IS CRITICAL, NOT ONLY TO THE THOUSANDS OF US WHO WORK IN THIS INDUSTRY, BUT TO THE FUTURE OF AMERICA AND OUR NATIONAL ECONOMIC BASE..

HISTORY

BEFORE THE INDUSTRIAL REVOLUTION, THE PRODUCTS OF THE SOCIETY WERE MADE BY SKILLED CRAFTSMEN. THESE FORERUNNERS OF TODAY'S TOOL AND DIE MAKERS AND MACHINISTS CRAFTED EVERYTHING FROM

CLOCKS TO PISTOLS INDIVIDUALLY, ONE PIECE AT A TIME. EACH WAS UNIQUE AND PRECISION MADE, BUT TOOK HOURS OF SKILLED TIME.

THE INDUSTRIAL REVOLUTION WAS MADE POSSIBLE BY THESE SKILLED CRAFTSMEN AND SOMETHING NOW KNOWN AS TOOLING. VERY SIMPLY, THESE HIGHLY SKILLED PEOPLE WERE PUT TO MORE EFFICIENT USE, MAKING MORE PARTS PER UNIT TIME.

RATHER THAN MAKING A SINGLE PART THEY WOULD MAKE A DIE THAT WAS EQUALLY EXACT. FROM WHICH THOUSANDS OF IDENTICAL PARTS COULD BE STAMPED ON SIMPLER MACHINES OPERATED BY LESS SKILLED WORKERS. IN THE SAME WAY, MOLDS WERE MADE TO PRODUCE THOUSANDS OF PARTS FOR THOUSANDS OF DIFFERENT USES BY THOUSANDS OF MORE PEOPLE IN THE GENERAL POPULATION AT FAR LESS COST TO EACH INDIVIDUAL. THIS BECAME THE FOUNDATION AND THE UNDERPINNING OF ALL MODERN MANUFACTURING.

ELI WHITNEY CAME TO THE CONTINENTAL CONGRESS AND SHOWED THE YOUNG AMERICA HOW TO MAKE PRECISE, INTERCHANGEABLE PARTS FOR RIFLES SO THAT AMERICAN TO MASS-PRODUCE THESE WEAPONS FOR OUR REVOLUTION AT LOWER COSTS.

TAKE AWAY OUR INDUSTRY AND THE MACHINE TOOLS WHICH ARE USED IN OUR PLANTS, AND YOU TAKE AWAY THE ABILITY OF MOST OTHER U.S. MANUFACTURERS TO EXIST [AND ALL OF THE ABILITY OF OUR COUNTRY TO DEFEND ITSELF WITHOUT RELYING ON FOREIGN TOOLING.]

WE ARE NOT TALKING ABOUT A MODEST NUMBER OF FIRMS EMPLOYING A MODEST NUMBER OF EMPLOYEES. WE ARE PART OF THAT OVERWHELMING BODY OF AMERICAN FIRMS CITED BY THE DAVID BIRCHS. BY THESE NUMBERS ALONE ... AND OUR IMPACT ON OUR MANUFACTURING CUSTOMER ... WE ARE NOT A SPECIAL INTEREST GROUP.

TODAY, THE STATE OF TECHNOLOGY USED IN OUR FIRMS IS NOT AS GOOD AS IT SHOULD BE. WITH THE PRESSURES OF BOTH INTERNAL AND OVERSEAS COMPETITION, SURVIVAL IS BASED ON OUR INCREASED USE OF AUTOMATION, FROM CNC (COMPUTERIZED NUMERICAL CONTROLS), CAD/CAM (COMPUTER AIDED DESIGN/COMPUTER AIDED MANUFACTURING)

THROUGH TECHNOLOGIES SUCH AS FMS (FLEXIBLE MANUFACTURING SYSTEMS) AND CIM (COMPUTER INTEGRATED MANUFACTURING).

FOR COMPANIES TO SURVIVE IN THE NEXT TWO DECADES, FIRMS MUST COMMIT TO THESE TECHNOLOGIES TODAY.

PROFITABILITY

WHEN READING THIS, YOU MIGHT SAY THAT BUERK TOOL & MACHINE HAS BEEN A VERY SUCCESSFUL FIRM WITH A LONG LIFE OF BEING AT, OR NEAR, THE SO-CALLED "CUTTING EDGE OF TECHNOLOGY". PERHAPS IT HAS, PERHAPS NOT. ACCORDING TO THE NATIONAL TOOLING & MACHINING ASSOCIATION, THERE ARE 10,000 TO 12,000 FIRMS IN THE U.S. SUCH AS OURS. THE NTMA SHOWS THAT THE PROFIT FROM 1986 OF ITS SMALL BUSINESS MEMBERS WAS APPROXIMATELY 1% OF SALES. OUR FIRM LOST MONEY OVER THAT SAME PERIOD.

WITH THIS BACKGROUND, LET US TURN TO THE PROBLEMS OF AUTOMATION AND SMALL BUSINESS:

THERE ARE TWO TYPES OF SMALL BUSINESSES:

1. THOSE THAT ARE NOT YET BIG.
2. THOSE THAT, BY NATURE OF THEIR ACTIVITY, NEED TO STAY SMALL.

BEFORE THE GOVERNMENT MAKES DECISIONS, IT MUST UNDERSTAND THIS BREAK-DOWN.

SIZE

BACK IN THE LATE '60'S OR EARLY '70'S A FRIEND OF MINE WORKING FOR IBM VISITED OUR PLANT TRYING TO SELL ME ON THEIR SMALL BUSINESS COMPUTER OF THAT DAY, THE IBM 1130 (I THINK). KNOWING THAT I HAD SOME COMPUTER EXPERIENCE, MARK SUGGESTED THAT IT WOULD "CUT MY OFFICE STAFF BY A THIRD!" I SUGGESTED TO MARK THAT WE COULD NOT USE SUCH A DEVICE BECAUSE WE ONLY HAD TWO PEOPLE. (SINCE THAT TIME, COMPUTERS HAVE CHANGED, WE OPERATE 4 DESK-TOP COMPUTERS.)

THIS ANECDOTE DEMONSTRATES THAT MANY OF US DO NOT HAVE THE SCALE OF OPERATION TO TAKE ADVANTAGE OF MANY PARTS OF

AUTOMATION.

ON THE OTHER SIDE OF THIS COIN: WHEN I WAS INVITED TO APPEAR BEFORE THIS SUBCOMMITTEE, I CALLED A THREE-LETTERED COMPUTER COMPANY SELLING AMERICAN-MADE EQUIPMENT. I AM LOOKING FOR HELP ON FURTHER AUTOMATING MY PLANT BY RESPONDING TO THEIR ADVERTISEMENTS ON "COMPUTER INTEGRATED MANUFACTURING". IT IS NEW DECEMBER 2ND, AND I HAVE NOT HEARD BACK FROM THEM. THE REASON FOR THIS LACK OF RESPONSE IS THAT THE HIGHLY TECHNICAL AND HIGHLY MARKET-AGGRESSIVE FIRM HAS TROUBLE DEFINING MY NEEDS. THEY ARE TOO BIG. THEY FIND THAT WE ARE JUST NOT PROFITABLE AND THUS, NOT WORTHY FOR THEM TO BRING US UP-TO-DATE. SIZE IS A BIG PROBLEM FOR SMALL BUSINESSES.

FINANCE

YOU MUST RECALL THE **NTMA** STATISTIC SHOWING PROFITS BEING 1% OF SALES. IT IS EASY TO SEE HOW DIFFICULT IT IS TO FINANCE NEW TECHNOLOGIES INTERNALLY. AUTOMATION IS BRUTALLY EXPENSIVE REQUIRING RELATIVELY LARGE CAPITAL OUTLAYS. TRANSLATE THIS PERCENTAGE TO DOLLARS, AND COMPARE THAT TO A MILLION-DOLLAR PRICE TAG OF A FLEXIBLE MACHINING CELL.

1. WE USED TO REFER TO **SWEAT EQUITY** AS A SOURCE OF FINANCING A BUSINESS. HERE ONE WOULD BORROW FROM ONE'S FAMILY, MORTGAGE THE HOUSE, INVEST ONES SAVINGS TO AMASS ENOUGH TO GET THE BUSINESS GOING. TODAY, THE COST OF THESE AUTOMATED CONFIGURATION IS JUST TOO MUCH TO ASK THE FAMILY AND FRIENDS FOR HELP.

2. IT IS DIFFICULT TO FINANCE INTERNALLY FROM PROFITS SET IN **RETAINED EARNINGS**. BECAUSE PROFITS ARE NOT THERE. OUR HIGHLY COMPETITIVE SECTOR HAS BECOME EVEN LESS PROFITABLE BECAUSE OF FOREIGN COMPETITORS. I SHOULD KNOW, BECAUSE OUR PLANT SITS NEXT TO A BORDER. WE HAVE LOST BUSINESS ON FEDERALLY-FUNDED SUBCONTRACTS IN THE AEROSPACE MARKET TO CANADIAN COMPETITORS. I SHOULD KNOW BECAUSE WE TRY TO PURCHASE, WHENEVER POSSIBLE, AMERICAN-MADE MACHINE TOOLS AND OTHER EQUIPMENT. [I SHOULD KNOW BECAUSE I AM PERSONALLY TRYING TO BUY AN AMERICAN-MADE AUTOMOBILE.]

3. IF ONE CANNOT ACCUMULATE PROFITS THROUGH RETAINED EARNINGS, ONE HAS TO SEEK EXTERNAL SOURCES OF FINANCING. THE FIRST SOURCE WOULD BE YOUR "FRIENDLY BANKER". BANKS ARE TRADITIONAL, CONSERVATIVE (NOT PRONE TO RISK) AND HAVE NEVER FAVORED SMALLER BUSINESSES WITH PRIME RATES. THEY DO NOT CONSIDER AUTOMATED EQUIPMENT AS GOOD COLLATERAL. BANKS WANT YOUR HOME AND OTHER MARKETABLE ASSETS AS SECURITY. YOUR NEW AUTOMATED EQUIPMENT MAY BE A VALUE TO YOU, BUT NOT TO YOUR LOW-TECH BANKER. YOU CANNOT ASK YOUR BANKER FOR SUPPORT IN PROJECTS RELATED TO NEW TECHNOLOGIES. IT IS UNFAIR TO THEM TO EXPECT THEM TO BE THAT CLOSE TO THE TECHNICAL EDGE. THE RISK IS JUST TOO HIGH.

4. ANOTHER SOURCE IS THE LESS-TRADITIONAL VENTURE CAPITALISTS WHO REALLY DO NOT EVEN GET INTERESTED UNLESS THERE IS AN EQUITY POSITION FOR THEM. WHEN YOU ARE SMALL, SLICES OF THE SMALL EQUITY PIE ARE NOT ATTRACTIVE. IF THEY WERE, FEW OF US WOULD SEEK THIS SOURCE, PARTICULARLY AFTER THE PAINS IN THE COMPUTER INDUSTRY AFTER "BLACK MONDAY".

5. WE ARE MOSTLY TOO SMALL AND UNDERWRITING COSTS ARE TOO COSTLY FOR US TO GO PUBLIC. WITH THAT LOW PROFIT INCOME, I KNOW WE ARE NOT ATTRACTIVE TO THE EQUITY MARKETS.

6. MANY EQUIPMENT BUILDERS DO OFFER FINANCING. THE OLDER AND SURVIVING FIRMS LEFT IN AMERICA HAVE BEEN QUITE SUCCESSFUL IN "UNDERWRITING" THEIR CUSTOMERS. THEY KNOW THE EQUIPMENT. THEY KNOW THE BUYER. THEY KNOW THE APPLICATION. THEY KNOW THE RISKS.

7. THE LEAST ATTRACTIVE SOURCE IS THE GOVERNMENT OR THOSE QUASI-GOVERNMENTAL AGENCIES; AS AN EXAMPLE, YOUR LOCAL INDUSTRIAL DEVELOPMENT AGENCY ISSUING INDUSTRIAL REVENUE BONDS:

WE HAVE SEEN PACKAGES GIVEN TO INDIVIDUAL FIRMS, MY COMPETITORS AND MY CUSTOMERS. THEY ARE GIVEN FINANCIAL PACKAGES RESULTING IN LOANS WHICH MAY BE 2% UNDER PRIME AND WHERE THEY RECEIVE STATE AND/OR LOCAL TAX

FORGIVENESS OR REDUCTIONS. THESE IRB ARE TO CREATE NEW JOBS, **NET NEW JOBS**. BUT WE FIND THAT THEY MERELY MOVE JOBS FROM ONE PLANT TO ANOTHER PLANT ... FROM ONE PART OF THE COUNTY TO ANOTHER ... OR FROM ONE STATE TO ANOTHER.

IRB CERTAINLY ARE USED WITH GOOD INTENT BUT MY FIRM AND OTHERS HAVE BEEN VICTIMS OF THESE PACKAGES. A COMPETITOR OF OURS RECEIVED IRB FUNDS. THEY WENT TO OUR CUSTOMER AND TOLD THEM THAT WHATEVER BUERK TOOL WAS CHARGING, THEY WOULD MAKE FOR 15% LESS. WE LOST 14% OF OUR BUSINESS. THEIR COSTS WERE ARTIFICIALLY LOWERED BASED ON THESE EXTERNAL ECONOMIES. AT THAT TIME, WE WERE PAYING SMALL BUSINESS MARKET RATES ON OUR LATEST AUTOMATED TURNING CENTER WHICH THEY IDLED.

DO NOT MISTAKE THIS OBSERVATION: I AM NOT SAYING THAT THESE "DEALS" ARE DONE WITH MALICE ON THE PART OF THESE AGENCIES. IN CONTRAST, I AM NOT CONVINCED THAT THE PARTICIPATING FIRMS ARE ABOVE-BOARD.

EACH TIME A FIRM GETS DIRECT HELP, MY FIRM'S TAXES GO UP TO OFFSET THE LOSE OF STATE AND LOCAL TAXES WHICH THESE FIRMS AVOID AND MY MARKET-POTENTIAL IS REDUCED. MY LABOR-FORCE IS ALSO REDUCED. MY FIXED COSTS REMAIN FIXED. JOBS ARE MERELY TRANSFERRED FROM ONE PLANT TO ANOTHER. THE FUTURE OF MY EMPLOYEES IS THREATENED. THE PLAYING FIELD IS EVEN MORE UNEVEN. NO DEVELOPER OR AGENCY DIRECTOR EVER TALKS ABOUT **NET NEW JOBS**.

TECHNOLOGY

THERE IS A JOKE WITHIN OUR INDUSTRY WHICH ASKED "WHY SHOULD WE AUTOMATE OR MODERNIZE, BECAUSE ANYTHING WE BUY IS OBSOLETE?".

TECHNOLOGY IS ADVANCING RAPIDLY IN OUR INDUSTRY. IT IS BECOMING EVEN MORE SOPHISTICATED, MORE EXPENSIVE, AND MORE QUICKLY TECHNOLOGICALLY OBSOLETE.

SENATE OFFICES NOW HOUSE PERSONAL COMPUTERS. MANY OF YOUR OFFICES PURCHASED SUCH DEVICES THIS YEAR. AND AS WE TALK, NEWER AND IMPROVED COMPUTERS ARE REACHING THE MARKET PLACE, TECHNICALLY OBSOLETING YOURS (AND MINE). EVEN NOW, THERE IS SOME PERSON IN SOME CELLAR OR GARAGE OR LABORATORY OBSOLETING THE COMPUTER WHICH OBSOLETED YOURS (AND MINE). THE SAME IS HAPPENING WITH LARGER PRICE-TAGGED MACHINE CONFIGURATIONS.

MANY SMALL BUSINESS PEOPLE THROW UP THEIR HANDS IN FRUSTRATION ASKING "WHY", RATHER THAN "WHY NOT". IT IS DIFFICULT, MANY TIMES, TO JUSTIFY AN ACQUISITION ON A CONCEPTUAL, OR TECHNICAL, LEVEL AS ON A FINANCIAL LEVEL IN LIGHT OF THE ACCELERATING CHANGES IN TECHNOLOGY.

KNOWLEDGE

I HAVE FELT FOR A LONG TIME THAT, IN TERMS OF "WHAT IS OUT THERE", I DO NOT HAVE ADEQUATE INFORMATION AS TO WHAT I SHOULD DO NEXT TO KEEP OUR PEOPLE AND OUR EQUIPMENT UP-TO-DATE AND AS COMPETITIVE AS WE POSSIBLE CAN.

LACK OF INFORMATION IS A BARRIER TO THE APPLICATION OF NEW TECHNOLOGIES. MOST COMPANIES ARE PARTIALLY INFORMED THROUGH TRADE PUBLICATIONS AND ADVERTISING. MANY OF US CAN SEE APPLICATIONS AT TRADE SHOWS UNDER IDEAL CIRCUMSTANCES. WHAT WE CANNOT DO, HOWEVER, IS TELL HOW IT WILL WORK ON THE SHOP FLOOR. WE ARE NOT ABLE TO COMPARE AND DECIDE HOW FAST AND HOW WELL IT WILL WORK IN THAT REAL-WORLD ENVIRONMENT. WE NEED TO KNOW HOW OFTEN IT CAN BE EXPECTED TO REQUIRE SERVICE AND REPAIRS AND HOW LONG THAT SERVICE AND REPAIR REQUIRES. WE NEED TO KNOW WHETHER IT WAS EASY OR DIFFICULT FOR THE OPERATOR TO USE AND HOW LONG IT TAKES TO SHIFT FROM ONE JOB TO THE NEXT.

MARKET

IN MANY CASES, TO JUSTIFY A PURCHASE OF NEW, AUTOMATED EQUIPMENT ONE HAS TO RUN THREE-SHIFTS. QUALITY DEFINITELY DETERIORATES AFTER THE FIRST SHIFT. IF QUALITY IS IMPORTANT THE SECOND SHIFT IS A THREAT.

EVEN IF ONE WERE TO OPERATE IN A SINGLE SHIFT THE VOLUME OF OUTPUT IS SUCH THAT IT COULD OUT-PRODUCE WHAT THE MARKET COULD CONSUME. UNLESS THAT FIRM CAN FIND BUYERS FOR THE

PARTS BEING PRODUCED IT COULD BE IN TROUBLE.

MOST OF US IN THE METALWORKING INDUSTRIES HAVE HAD A HISTORY OF TECHNICAL EXCELLENCE, BUT THE VAST MAJORITY OF US HAVE RECEIVE VERY LOW MARKS IN OUR MARKETING EFFORTS. EVEN IF WE WERE ABLE TO FORD ALL THE BARRIERS IN TERMS OF FINANCING AND TECHNOLOGY, MANY OF US WILL STUMBLE AT TRYING TO SELL WHAT WE HAVE PRODUCED. AUTOMATION MEANS GREATER OUTPUT PER UNIT TIME. THIS MEANS GREATER SELLING PRESSURES ON THAT FIRM. SOME FIRMS MIGHT NOT HAVE THE ABILITY TO FIND ENOUGH CUSTOMERS TO SELL ALL THEY CAN MAKE WITH ADDED AUTOMATION.

WHERE TO GO

I AM NOT CONVINCED THAT TRADITIONAL FINANCIAL AID FROM THE GOVERNMENT IS THE BEST WAY TO SOLVE THE PROBLEMS OF INSTITUTING MORE AUTOMATION IN SMALL BUSINESS. I DO FOLLOW THE DICTUM THAT "TAXES DISCOURAGE, WHILE SUBSIDIES ENCOURAGE."

AS PRESIDENT KENNEDY OFTEN SAID "ALL BOATS, BOTH LARGE AND SMALL, SHOULD RISE AND FALL WITH THE TIDE."

1. I SUGGEST THAT WE RETURN TO FORMS OF **INVESTMENT TAX CREDITS** AND **ACCELERATED DEPRECIATIONS** WHERE WE CAN ENCOURAGE FIRMS TO INVEST AND REINVEST TO MAKE OUR PLANTS, BOTH LARGE AND SMALL, COMPETITIVE NOT ONLY IN LOCAL BUT INTERNATIONAL MARKETS. [I HAVE BEEN TOLD THAT THE BRITISH ALLOW MY COMPETITORS TO **EXPENSE** THEIR CAPITAL ACQUISITIONS.] BY DOING THIS, WE WOULD ENCOURAGE ANY FIRM, IF NOT ALL FIRMS, TO AUTOMATE, BUT NOT AT THE EXPENSE OF OTHER. IN THIS WAY, THERE ARE NO VICTIMS.

   BESIDES FEDERAL AND STATE GOVERNMENTS WILL GET THOSE "LOST" TAXES ... AND, MORE, THROUGH HIGHER CORPORATE TAXES AND ADDED EMPLOYEE INCOME TAXES ... AND REDUCED SOCIAL COSTS WHEN MORE PEOPLE WORK. THIS IS WHAT WE CALL A "TWO FOR" WHERE HIGHER EMPLOYMENT YIELDS MORE TAX REVENUES PLUS FEWER UNEMPLOYMENT COST. LOOK AT NEW YORK STATE WHERE WE HAVE CUT TAXES AS OUR EMPLOYMENT INCREASED.
2. I CAN ENVISION SUCH GROUPS AS THE **NTMA** CREATING **TECHNICAL**

ASSISTANCE CENTERS, HIRING TECHNICAL STAFF TO PROVIDE UNBIASED AND COMPETENT ASSESSMENTS OF AUTOMATION CONFIGURATIONS TO ITS MEMBERS. I SUGGEST SUPPORTING PROFESSIONAL GROUPS IN TERMS OF GRANTS FOR RESEARCH AND TECHNICAL ASSISTANCE TO ACT AS INFORMATION BASES SIMILAR TO DATA-BASES. WE HAVE TO START POOLING INFORMATION AS OUR FOREIGN COMPETITORS HAVE DONE FOR MANY YEARS.

3. THE FEDERAL GOVERNMENT HAS A SCORE OF TECHNICAL CENTERS FROM WHICH UNBIASED AND LEARNED INFORMATION CAN BE EVALUATED AND BROADCASTED. I LOOK TO **ARSENALS, LABORATORIES, PROVING GROUNDS,** AND SO ON. PARTS OF OUR GOVERNMENT ARE VERY UP-TO-DATE. YET PROPRIETARY.
4. THE GOVERNMENT ALREADY HAS A NETWORK IN THE **SMALL BUSINESS DEVELOPMENT CENTERS** DEALING WITH INDIVIDUAL BUSINESSES. THIS ROUTE CAN BE TAPPED.
5. WITHOUT EMPLOYERS, WE CANNOT HAVE EMPLOYEES. WE SPEND A LOT OF MONEY ON RETRAINING EMPLOYEES. IT IS TIME TO **RETRAIN EMPLOYERS**. IN YOUR DEPARTMENT OF COMMERCE THERE IS A GREAT DEAL OF EXPERTISE RELATIVE TO APPLIED TECHNOLOGY. THE PEOPLE WITH THIS EXPERTISE MUST GET OUT TO THE EMPLOYERS AND MANAGERS TO BRING THEM UP-TO-DATE. THEY MUST GET INTO THE FIELDS.
6. IT IS TIME TO GO TO OUR **UNIVERSITIES**, PARTICULARLY OUR LAND-GRANT UNIVERSITIES,. TO TAP THEIR APPLIED EXPERTISE IN TERMS OF RESEARCH, TECHNICAL ASSISTANCE AND TRAINING OF BOTH EMPLOYEES AND EMPLOYERS. WE MUST DEVELOP RAPPORT BETWEEN THE SMALL MANUFACTURER AND THE CAMPUS IN THE SAME TRADITION THAT HAS LINKED OUR FARMERS TO CAMPUSES FOR GENERATIONS.
7. **PROCUREMENT FAIRS:** SENATOR D'AMATO HAS SPONSORED SUCH GATHERINGS WITH GOVERNMENT PRIME CONTRACTORS IN NEW YORK TO DEVELOP ECONOMIC RELATIONSHIPS BETWEEN BUYERS AND POTENTIAL SELLERS. MORE OF THIS NEEDS TO BE DONE. THE **NTMA** ORGANIZES SUCH EVENTS. THIS AND OTHER PROFESSIONAL GROUPS SHOULD BE ENCOURAGED. THESE FAIRS CAN HAVE SUBSTANCE AND THE ORGANIZERS SHOULD, SOMEHOW, TO BE REWARDED.

6. THE SINGLE, DARKEST CLOUD OVER BOTH LARGE AND SMALL AMERICAN INDUSTRY IS JAPAN. IT IS HIGH TIME THAT WE NO LONGER FAVOR THEM AS AN EMERGING NATION. I HAVE BEEN TOLD THAT THEIR BANKING SYSTEM, ALONE, IS NOW LARGER THAN OURS. THEIR MACHINE TOOL INDUSTRY DOMINATES OURS. WE HAVE LOST STEEL. WHEN WE WERE CHILDREN, WE USED TO REFER TO THE AUTOMOTIVE INDUSTRY AS "THE BIG-3 PLUS AMERICAN MOTORS". NOW WE TALK OF THE "BIG-11".

LITTLE OF THIS HAS BEEN TAPPED.

I APPRECIATE YOUR INVITATION TO APPEAR BEFORE YOU. IT IS NOT EVERY DAY THE A SMALL BUSINESS PERSON, SUCH AS I, IS INVITED TO THE SENATE. I DO NOT HAVE A PUBLIC RELATIONS OFFICER TO WRITE THIS TESTIMONY. I HAVE NO RESEARCHER OR SECRETARY. ALTHOUGH I DID HAVE SOME HELP, I DID MOST OF THE TYPING MYSELF DURING THE THANKSGIVING WEEKEND. WHEN YOU ARE IN SMALL BUSINESS, THERE IS NOT A LOT OF HELP. BETWEEN TYPING AND THINKING OF WHAT I WAS TRYING TO SAY, I HAD TO KEEP ALL OF US EMPLOYED. AT 4:00 THIS AFTERNOON, I AM GOING BACK TO THE RUST BELT. I AM GOING BACK TO WORK, BUT I AM RETURNING WITH A LITTLE MORE OPTIMISM, WITH HOPES THAT WHAT YOU HAVE HEARD TODAY MIGHT STEER US AWAY FROM THE DANGEROUS PATH ON WHICH WE TRAVEL.

THANK YOU FOR INVITING ME, MR. CHAIRMAN. THIS CONCLUDES MY TESTIMONY.

National Tooling & Machining Association

NTMA
PRECISION

SUBMITTED TESTIMONY
ON BEHALF OF THE
NATIONAL TOOLING AND MACHINING ASSOCIATION
DECEMBER 2, 1987
BEFORE THE
SENATE SMALL BUSINESS SUBCOMMITTEE ON
INNOVATION, TECHNOLOGY, AND PRODUCTIVITY
CONDUCTING HEARINGS ON
SMALL BUSINESS AUTOMATION

9300 Livingston Road • Ft. Washington, Maryland 20744 • (301) 248-6200

INTRODUCTION

Before the industrial revolution, the products of society were produced by skilled craftsman. These forerunners of today's journeyman tool and die maker or machinist crafted everything from pistols to pocket watches individually, one at a time. Each was unique and precision made, but took many hours of the skilled craftsman's time.

The industrial revolution was made possible by these skilled craftsmen and something known as tooling. Simply put, these highly skilled craftsmen were put to more efficient use.

Rather than making a single precise part they would make a die that was equally precise, from which thousands of precise identical parts could be stamped on simpler production machines run by less skilled workers. In much the same manner today, they also make equally precise molds in which thousands of plastic, metal and other parts for thousands of different uses could be manufactured. Thus this tooling, as well as precision machining, is the foundation and the underpining of all modern mass manufacturing.

Take away our industry and the machine tools which are used in our shops and you take away the ability of most other U.S. manufacturers to exist and all of the ability of our country to defend itself without reliance on foreign tooling. The typical production worker simply has neither the training nor skills to produce the often complex and precise tooling essential to his production machines.

It is for these reasons, rather than the modest number of companies and the modest number of workers in the industry, that we think this Committee is wise to be concerned about the state of technology application in our industry.

CURRENT STATUS

We are sorry to have to tell you that the state of technology application is not as good as it could be and nowhere near as good as it should be. Most of the companies that survive the next decade or two will be those that have steadily increased their use of the state of the art equipment, from CAD/CAM (computer aided design/computer aided manufacture) to other state of the art technologies including flexible manufacturing/computer integrated manufacturing.

Sadly, many that fail will be companies that also recognize the importance of technology and knew what was available, but they were unable to afford it. Part of the reason for their failure will be that their present competitors in Japan, Germany and several other developed nations in many cases already have higher technology in their shops than the U.S. company today.

PROFITS

There are several barriers to technology application in our industry. The first and the greatest is profits. The 12,000 companies in the industry compete with each other intensely. They and their journeyman tool and die makers, who are among the highest skilled and highest paid blue collar workers in the country, also compete with foreign companies and workers. Foreign workers are getting more skilled all the time but still don't earn as much, even after the dollar's recent devaluation.

That explains why industry pre-tax profits averaged 1.1% in 1986 according to the National Tooling and Machining Association's annual Operating Cost and Executive Compensation Survey. There is good news in that industry profits in the ten years before were better. There is bad news in that they weren't that much better.

When you translate these percentages to dollars, and compare them to the million-dollar price tag of a flexible machining cell, you will understand why this equipment can seldom be financed internally (average net sales of $461,466 X 1.1% = $5,076 pre-tax profits per company).

FINANCE

Speaking of finance, banks often won't, and owners sometimes shouldn't. Banks are understandably reluctant to finance high technology because they don't understand it. You can't expect a banker to be as close to the technological edge as the shop owner. For a small company, interest rates approaching double digits impose a huge "load" that must be recovered through productivity. A small company typically pays a couple of points over the prime, so when the prime rate hits 8% or so, interest starts to add a very uncomfortable drain on productivity. Any company that does not keep an eye on the way interest drags down productivity is asking for trouble.

One state level program that does lower effective interest rates is industrial development or revenue bonds. They can lower the interest rates on equipment to as much as 2% below prime. This improves the ability of firms fortunate enough to qualify for an IDB to compete with foreign firms.

There is a downside which results from the fact that there are not enough IDBs to go around. The selective nature of IDBs exposes one counterproductive characteristic: rather than create new U.S. jobs at the expense of foreign workers, to some degree IDBs shifted jobs from one U.S. company to another. Since both federal IDB restrictions and the realities of state budgets effectively prevent universal availability of IDBs, there will always be some degree of domestic job shifting resulting from the program. This domestic job shifting does not benefit the state or the country, although any net new U.S. job creations benefits both. For these reasons, lower U.S. interest rates would be much better achieved through federal budget reductions as compared to programs with selected beneficiaries such as IDBs.

TECHNOLOGY

Technology is advancing rapidly in our industry. Equipment is becoming ever more sophisticated, more expensive and more quickly technologically obsolescent. This carries with it a number of implications.

First of all, more sophisticated equipment requires more sophisticated operators. That in turn requires more training of workers who are already among the most heavily and best trained in the country. In addition to the 6-700 classroom hours and the four years apprenticeship still required to reach journeyman status, our workers today must also learn computer sciences. These skills in no way replace the traditional skills required of a journeyman, but rather add to them. This adds another cost to total investment required to implement the latest technology.

Also, as equipment becomes more sophisticated, it becomes more complicated and sensitive. At the same time, the cost of today's equipment makes maximum utilization of equipment imperative if a company is to be competitive. In some cases, you have to run two daily shifts, or even three, to achieve the needed unit cost reductions to justify the purchase. You cannot assume that sophisticated equipment will run as long without breakdown as the more basic equipment of decades past. Therefore, the relative reliability of the equipment alternatives and the speed with which the machine tool builder can service the equipment and have it back running are critical components of the purchase decision.

Lack of this information is a barrier to the application of new technologies. Most companies in our industry are well informed through industry trade publications and company promotional efforts of what new technologies exist. They know what the equipment is capable of doing under ideal circumstances through advertising literature and from sales representatives.

What they don't know is how it will work in the shop floor environment. To be able to compare and decide they need to know how fast and how well it will work in that environment. They need to know how often it can be expected to require service or repairs and how long that service or repair requires. They need to know whether it is easy or hard for the operator to use and how long it takes to shift from one job to another.

The National Tooling and Machining Association's machine tool users survey helps companies in our industry make those kinds of decisions, but there is precious little data on the very latest state-of-the-art equipment. What is needed is programs like the proposed National Institute of Flexible Manufacturing strategically placed in manufacturing areas across the country. This shared Flexible Computer Integrated Manufacturing (FCIM) program, to be conducted in cooperation with the Commerce Department Office of Productivity Technology and Innovation (OPTI) and the National Bureau of Standards (NBS), would fill an important void.

Under the program, developed by OPTI, and to be funded primarily by the private sector, a national teaching factory equipped with the state-of-the-art Flex/CIM technology will operate 24 hours a day, three shifts a week. A company could have its workers trained on this new equipment. These workers would be making parts for customers on this equipment, enabling the shop owner to answer some of the questions previously posed. As a result, the owner would be equipped to decide whether or not to purchase that equipment for his shop, and most importantly, learn how to manage FCIM systems since the technology by itself does not improve competitiveness. This shared manufacturing service center would be self sustained by reasonable fees paid by participating companies for the use of the equipment and their employees' training.

Another benefit of what amounts to a shared leasing program is its benefits to the small companies in the industry which typically have 20 or 25 employees. In many cases, the productivity of state-of-the-art equipment is so great that a small company is unable to sell enough hours on a new piece of equipment to justify its purchase. Such a program would enable a number of companies to each use and pay for the hours they need, giving them the productivity enhancement without the unaffordable costs of underutilized equipment.

A third benefit would accrue to the builders of the equipment. They would be able to study, in one facility, the myriad of applications to which the equipment is being put. This would both aid the refinement of designs and the development of new designs.

Under the provisions of S.907, the Technology Competitiveness Act of 1987, twelve regional centers for transfer of manufacturing technology will be created through NBS which would compliment and further enhance the impact of the shared FCIM program. We urge members of this Committee to support this provision in negotiations on the trade bill and in subsequent Senate floor votes on the completed trade package.

For an even more eye opening example of potential federal programs to increase the rate of transfer of manufacturing technology, we suggest that you study "Manufacturing Networks and Reindustrialization" by C. Richard Hatch. This federally funded study of successful ongoing reindustrialization programs in Italy shows what this country could easily achieve domestically if we wanted our country to be the world leader in industrial technology. Of particular interest is the contribution of the Italian model to enhancing the marketing capabilities of the smaller firms which participated in the programs.

TAXES

Tax policy plays a critical role in the transfer of technology. With industry profits as low as they are it is often difficult to finance even a 10% downpayment internally. However, the recently repealed 10% investment tax credit provided a mechanism for effectively shifting what would have been quarterly federal income tax payments to a downpayment for a machine that would create new jobs and new tax revenues. Similarly, the previous schedule for accelerated depreciation helped small companies in many cases to keep up with advances in technology. Today, the federally allowed depreciable life of equipment is longer at a time when the duration of a piece of new equipment's competitiveness in world markets is continually shortening.

Proponents of the tax reform measures in the last Congress argued that the changes made would make investment decisions with respect to equipment versus labor, or one kind of business versus another, more neutral. That much is true. In a system with closed national borders, the changes would also be fair.

They ignored the fact that our borders are not closed to manufactured products and that trade between nations increases every year. For those reasons, our competitors in England who can expense their equipment, our competitors in Canada with their subsidy programs, and our competitors in Japan with their lower interest rates are advantaged over us. Thus, the new tax code is not neutral with respect to the U.S. manufacturing sector's competitive position in world markets. While it may make investments in U.S. retail, wholesale, service or construction industries more tax neutral, the current U.S. tax code basically says to anyone considering investments in manufacturing that they should make the investment in another country.

On the other hand, labor costs, which are expensed under tax laws of most nations, are therefore treated the same in most countries. Since they are treated the same, the incentive then is to produce in countries with the lowest labor costs. Manufacturing labor costs in the U.S. are among the world's highest and labor costs in our industry are among the highest in the U.S.

What is needed is for this Administration and Congress to recognize that in a world trading environment, tax laws are a defacto industrial policy, whether you like it or not, or whether you want them to be an industrial policy or not.

In general, we believe that a favorable tax policy would be a more efficient element of a proactive U.S. industrial policy than would be subsidy programs. We would suggest that a consumption tax, particularly one like the Business Transfer Tax conceived by Senator Roth would improve U.S. competitiveness and have several other benefits as well. The tax would encourage more savings in the U.S., which is badly needed. Those savings would result in lower interest rates. The proceeds of the tax could be used to restore a carefully targeted ITC and more generous depreciation for carefully targeted productive equipment. There would be enough proceeds from such a tax even at a modest rate to further reduce the federal debt and thus interest rates as well.

MARKETS

We in our industry have to become better at marketing. There are inherent constraints imposed on companies with 20 employees, 3 or 4 of whom must carry out all administrative functions including marketing. The National Tooling and Machining Association runs excellent marketing conferences, seminars, and procurement fairs, where we meet one on one with potential customers.

Some of the barriers are not ours. Earlier this week a small firm in our industry successfully protested a $2.5 billion Air Force sole source spare parts contract. That works out to $250,000 for each of the 10,000 companies in our industry. If those 300 different parts are procured competitively as directed by GAO, the companies will have a chance to bid on this work and may earn enough to justify additional equipment purchases. Also, if past history repeats itself, the Air Force will save 40%, or about $1 billion, over the life of the contract.

The Defense Department buys $22 billion worth of spare parts each year. Most of that work is unfairly closed to most tooling and machining companies except those that are fortunate enough to work as subcontractors. Instead, the government usually pays unconscionably high prices on sole source procurements from the nation's largest defense contractors. DoD often won't let capable firms bid on parts because of artificial and unjustified restrictions on who can bid. Others can't bid because the government has lost all or parts of blueprints, or data packages, or because they have become so illegible they can't be deciphered. In other cases, they can't get the data packages by the bid deadline except through data brokers who fill a market niche that was created by bureaucratic incompetence. New procurement reform legislation could save the federal government several billion dollars a year in spare parts purchases alone by simply increasing competition. In addition to contributing to a reduction of the federal deficit, we would broaden and thus strengthen the defense industrial base. We urge this Committee to conduct oversight hearings on this subject early next year.

Senator LEVIN. Thank you.

That last subject is indeed a very sore point with many of us, and we have had a lot of long speeches that we have made on it, and we will not make it now, but could not agree with you more on that issue, let me just tell you.

Mr. BUERK. If I could interject something, machine toolbuilders had something called the Houdaille Petition that they served the President in 1980 which has never been acted upon, something perhaps the Senate could dust off and look at again.

Senator LEVIN. There are a number of them that fall in that category, I am afraid not just with this Administration, in all fairness, as critical as I am of it, in the export trade area, but also prior administrations have simply not been aggressive in enforcing existing trade laws much less seeking new authority to level out the playing field, as you put it.

Our last witness on this panel is Mary Conran, and as I mentioned before in introducing this panel, she is the president and the CEO of Warren Industries, Inc. of Philadelphia.

Ms. Conran, we welcome you, and you can proceed with your statement, a summary of it, preferably, so we have a little time left for some questions.

STATEMENT OF MARY CONRAN, PRESIDENT AND CEO, WARREN INDUSTRIES, INC., PHILADELPHIA, PA

Ms. CONRAN. I will try to keep my statement brief.

I think you will find that my statements parallel Mr. Buerk's quite a bit. We happened to speak on the phone recently, and I found a new friend, someone who shared many of the frustrations that we have regarding technology.

Warren Industries is an old line manufacturing company, founded back in 1908 in Philadelphia. We are in an industry that it is almost gone here in the United States, the opto-mechanical instrumentation industry. In 1970, U.S. manufacturers had over 80 percent of the domestic market share. Now we have about 9 percent, but my latest figures say about 7½ percent market share. So we are talking about an industry that has faced very severe foreign competition.

Our industry was comprised of companies very similar to Warren Industries, small, family-owned, closely-held companies. Employees stayed with us for years. I have an employee with me right now who has been with us for 43 years, and once he got over the shock of me being president, we have been working pretty well together.

I do not come from a manufacturing background by birth, but I wish I had. My father is a college professor and I grew up studying marketing. I thought that was the solution to everything. Well, as I began to work, I found that what I really wanted was to be in a machine shop. And I resented my father for liking advertising so much because everything that we do, everything that has to do with our industrial base is rooted in manufacturing.

At Warren Industries, we do a little bit of metalworking. Maybe Mr. Buerk can help me with some of that. We create value for our industry, for our economy, and our markets through our assembly processes. Machine tools were never a big item in our production processes. But, we found that as foreign competitors began to enter our markets, they had integrated both process technologies and product technologies. They took away all the mirrors, prisms, mechanical assemblies, and replaced them with electronic systems that just supersede anything we were capable of doing.

At that time there were about 30 companies in our industry. A lot of them just jumped out of the market and said no way, we cannot do it. We were able to develop with the then-president's marketing insight, a very narrow niche strategy that has proved very successful for the company. What this message involved was saying, " What are we very good at doing?" A market-oriented approach: What are our capabilities, what can we learn from all this technology that is available?

We decided to choose certain product lines, some we were familiar with, some we were not, and just go into them. Back in 1980, the most technological thing we did was screw in a couple of lightbulbs into our instruments.

Now we make software systems that they use out in Arizona and Nevada, where they do nuclear testing. We make instruments that calibrate airplanes and landing systems. We also still manufacture our survey instruments product line. We are the last truely U.S. manufacturer of survey instrumentation.

But we have had a lot of problems along the way. We did have a major change in our marketing strategy, and to compete in our changed industry required a different financial base.

Here was a small, family-owned company that in 1979 and 1980 had about 30 employees. Yet we knew we needed more capabilities, we needed machine capabilities, we needed quality control upgrades. We needed many things.

In 1980, John Warren, chairman of the company, went to the SBA and was able to put together a loan package. The SBA has been proven to be our greatest ally. The loan package was installed in 1981. We were able to purchase equipment, upgrade tooling, put in a clean room for electronic assembly, purchase basic test equipment. I mean, we thought we were on the brink of technology.

The company continued to grow, and by successfully implementing its marketing strategies, also increased its sales volumes significantly. In 1980 we had sales of about $1 million. In 1986 we did $3.2 million.

At the end of last year the company had 76 employees and an order backlog of over $2 million. We were performing on Government contracts, and trying to buy equipment. There were many technology related things we wanted to do, but we were looking for help to do them.

Unfortunately for us, we did not get very much help from commercial sources. In fact, right now we are at odds with our bank, as I state in my testimony. We have had our loans called and our creditline closed. Many horrible things have happened to the company because we grew too fast.

We grew in our sales volume without an increase in the rest of our infrastructure. So, while we were able to integrate technology in one aspect—and not as fully as perhaps we should have in our manufacturing—we were lacking technology in other areas; in the way we handled our order processing and our inventory control.

Here was a small company that had been used to doing things the same way it was doing it back in 1942, and trying to apply all of the same rules.

We bought a computer, but I will tell you, this is one of the situations where all the computer does is manipulate information. No one knew how, or was told how, to analyze the data that it contained. Hence, a buildup in inventory resulted because we shifted product lines.

Many things were going on—changes—with the business. When I joined the company in 1986, I took a real hard line at what we had to do in terms of getting the company balanced, and part of that had to do with honing-in on our real needs, our technology needs. The company is a group of people who have been with the company a long time. The average length of employment with my company is 24 years.

I had women who were handling inventory who did not understand what they were doing. They did it for 18 years, but they did not understand what they were doing. We made them responsible for it. We involved them in the process.

I fell in love with the first PC I ever used. I would be lost without one. There is a woman at the company who could not understand how I could use a personal computer, she wanted to know why was I so smart?

We bought her a computer and put it in her office and turned it on, and every day we joked about what movie was on. Well, one day she got up, and walked over to the computer and said, "Can you show me how to use it?"

That started it.

Out in the shop they said, "This is the machine we want." We said, "Yes, we want the machine, too." We went to our technical assistance center, we asked for help. We also got a lot of help from the vendor. I was very pleased with the total approach the vendor took. Unfortunately, way back when, the wrong piece of equipment had been identified. We realize that now.

The process that we went through in trying to acquire that specific technology is what I want to make a basic thrust upon, as small businesses, we do not always know exactly what we need. We read our trade journals, we see ads in magazines that have overhead material-handling equipment, but all of this beautiful equipment, but how does that relate to us?

Here we are in an industry where the labor content is important, and pricing is important. But how will a machine tool off the shelf make a difference?

We had gone to our local technical center—actually, we were looking all over for help, and they came forward and said, listen, we will help you out. We will help you identify this piece of equipment you are going to need. It was the most fantastic piece of equipment I had ever seen, it had everything that anyone could ever want. The technical assistance center was able to help us by putting together cost analysis, which, coming from a consulting background, was rather sophisticated. I clearly understood what they were trying to do.

Here, for years we had been applying measurement tools and measurement analysis tools for our investments that were not necessarily appropriate. We began looking at different ways of analyzing payback or cost analysis.

Anyway, we got this wonderful recommendation, and in final developmental loan package we recognized we needed somebody to help us purchase the equipment because the working capital available to the company had been eaten up in our efforts to manufacture and market. And so there was a clear need for outside funding to acquire technology.

We found a joint city and State program that thought they could be helpful by offering a very attractive financing rate, so we spent hours on the applications and identified how many jobs we would save, and all the wonderful things this piece of equipment would do. We were then told the program was subject to budget cuts, and we had gotten too big and were no longer eligible for the program. It just fell through, and everyone was very frustrated.

I said, well, hey, let's take it to the bank, right? They care what happens. They have got $1.2 million worth of loans to us. Look how much money we are going to save. Look how much more work we are going to be able to do.

Well, that did not work out very well. They handed back the proposal. They did not even review it. They said, in essence, listen, you guys have gotten too big anyway and we are not really interested in manufacturing. We have got a deal here on credit cards, we can make 18 percent on credit cards, right, or we can do real estate deals. What do we want to do with manufacturing, particularly a little company your size. Here our company was doing almost $3 million.

Well, this is the overall attitude we continually get from financial institutions, so where is the incentive for small business?

Well, we quickly retreated and said, OK, we cannot buy the equipment, what *can* we do? And then we got real smart and said, "Do we need the equipment?" "What is our problem?" And our problem was, as a group and as the individuals in a group, we were not managing the technology available to us. Here we were, a smart group of people—we had strategic plans. I disagree with anyone who says small businesses do not plan long range or do not think strategically. We have a strategic plan.

The help we received through our technology assistance program was not basic enough at points, and at other points it was unsophisticated. We needed to go back to the basic premise.

Here was a company that had survived massive traumas in its industry because of its marketing strategy and due to the quality of its product. Yet, we had not gone back to some of the basics in solving the technology problem and, today, that is what we were building our company from. Taking a look at all of the available technologies; from inventory control and order processing to the variety of types of carbide tools that are now available. We now realize that we do not need a new piece of equipment. We only need a tool changer.

The tool changer would allow one person to run three machines at once. We do not need a new machine. We just need to be able to be smarter in our use of the ones we have.

Unfortunately, again, the source of financing for these up-grade products has been a problem for us. A lot of the measuring tools and financial analysis, functions that a banker routinely performs are not actually conducive to measuring a small manufacturer performance or needs. Other commercial financing sources or other financing sources do not seem geared toward the small manufacturer either. If you are making a high-tech product, there are venture groups that specialize, but I know of only one group that actually cares, that has targeted, mature industries for venture-type investment.

They are not real happy with my current financial situation right now, but I am dogging them to death, and the agenda of this hearing is exactly what this group is interested in, how do we get our basic industries to survive?

Yes, technology will do it, but we have got to overcome the problems that plague small business, including my company, because I do not think our situation is unique. I think it is a clear example of problems encountered by small business. We have problems identifying technology and in dealing with the frustrations of that, and also in obtaining funding.

Like Mr. Buerk, I do not mind being taxed. I do not mind paying high interest. We pay very dearly for our interest. I was recently offered a deal, 18 above prime, one deal I could not turn down. But we do have to figure out a way to get our financial institutions to encourage the small businesses to survive, because we are talking about U.S. industries, our basic industries, ones that have and continues to have value; the ones that have employment. There is a certain amount of innovation we perform, and there are all those wonderful economic and social things that the small businesses do, which I will not go into at this point, but we the small businesses, need help surviving.

[The prepared statement of Ms. Conran follows:]

STATEMENT OF

MARY CONRAN
PRESIDENT & CEO
WARREN INDUSTRIES, INC.

BEFORE THE
SUBCOMMITTEE ON INNOVATION, TECHNOLOGY, AND PRODUCTIVITY
OF THE
SENATE SMALL BUSINESS COMMITTEE
U.S. SENATE

DECEMBER 2, 1987

Remarks to the Senate Subcommittee on Innovation, Technology, and Productivity on Automation in Small Business Manufacturing

December 2, 1987

My name is Mary Conran and I am President/CEO Warren Industries, Incorporated - a small, closely and privately held, corporation, involved in the manufacture and marketing of opto-mechanical instrumentation.

My educational background is in Marketing and International Business Administration. Upon graduation to "the real world" my interests and personal goals quickly gravitated towards small manufacturing businesses. I joined Warren Industries, Incorporated in Mid 1986 after five years of consulting experience with small manufacturing companies.

By presenting information about my company and our experiences, I hope to provide first hand information relevant to the purposes of this committee: insight as it relates to the identification and further understanding of the nature of the problems encountered by small manufacturers in improving productivity and competitiveness through the use of appropriate technologies.

Warren Industries has encountered two specific problems in our efforts to integrate technology: identification of appropriate technology, and obtaining the commercial funding required to successfully integrate technology into our operation.

In spite of operating problems, including inadequate financing of our company, Warren Industries, Inc's 1986 revenues exceeded $3.2 million- up sharply from early 1980's annual sales volumes, which had averaged around $1 million.

We have a current order backlog of over $1.8 MM in both commercial and government contracts.

One hundred percent (100%) of revenues are derived from manufacturing operations and we currently employ 10 people on full-time basis, and 6 people on a part-time, as needed basis.

Although we continue to experience problems related to our recent growth, and despite our current financial condition, the company has been able to generate year-to-date sales revenue exceeding $1.8 million, and we estimate year end 1987 sales revenues will exceed $2.0 million.

Despite this strong performance, our relationship with our commercial lender has been strained over the last two years as the company has endeavored to adjust operations and manufacturing activities to reflect increased sales volume and changing working capital requirements which were an expected result from successful implementation of targeted marketing strategies.

We have been trying for two years to renegotiate our credit for more appropriate financing of our operation.

In August of 1987, our credit lines and commercial loans were closed, and the bank requested immediate payment of outstanding debts. In response, we were compelled to layoff over 40 employees, our company's first layoff in its 80 year history.

The decision by the bank to close our credit lines appears based upon their desire to focus their attention away from small business/manufacturing credits to more attractive sources of income.

We are currently negotiating with our lender to ensure continued paydown of our loans (which we have been able to reduce from $1.27 million in November 1986 to a current balance of $410,00), as well repayment of an SBA guaranteed loan-placed in 1980.

The following statement from our business plan summarizes our current requirements: "Our near term objectives are to improve the company's working capital asset base to take advantage of improved manufacturing technologies and strategies, and to provide sufficient working capital to support growing operations and enhanced marketing strategies".

Warren Industries, Incorporated was founded in Pennsylvania in 1908, and has operated in Philadelphia since its incorporation in 1913. Historically, the company manufactured surveyor's and builder's instrumentation for use in conducting ground surveys, layout of building foundations, etc.

Today, in strategic response to changing market conditions, the company manufactures, distributes and markets precision surveying, meteorological, metrological and aerospace instrumentation.

We manufacture, usually in relatively small production quantities, over twenty specialty instruments, all of which are available with certain user specific configurations.

Warren Industries faces extreme competition in our markets from foreign competitors; our industry has seen domestic market share shrink from over 80% in the early 1970's to approximately 9% of total current industry sales because of the aggressive and successful penetration of our markets by Swiss and Japanese manufacturers offering technologically upgraded products.

Many of our former competitors have exited our market in response to increased price competition, or after failure to successfully adjust product lines to reflect available technology.

Efforts to compete against the foreign competitors would involve a complete renovation of engineering and manufacturing processes as well as fast and furious upgrades in product technologies. The foreign competitors had quickly built expensive barriers to entry that had not previously existed.

Our industry was comprised of companies very similar in size and structure to Warren Industries-small, family-owned businesses with employees who had been with their company for at least thirty years. Instruments were made by hand, and machine tools provided enhancement of skills, not direct cost savings advantages.

When foreign competition began penetration in the early 1970's many of our domestic competitors had to immediately decide to "jump in" or "jump out" -there would be no room for or time for strategy.

Remaining U.S. competitors have been able to survive these conditions only under the following two scenarios: when larger and more financially resourceful companies could be attracted to acquire these companies, thereby providing the investment and working capital required to permit entry into new and changing markets; or where companies could capitalize on the ability of management in identification of attractive market segments built upon their strengths in marketing and manufacturing.

Warren Industries was able to develop and implement marketing strategies that would provide for sales volume growth in targeted markets.

While our current situation should not be considered "typical" the circumstances and situations which lead us to the present are similar to symptoms and problems faced by a broad range of small businesses: the identification of appropriate technology and acquisition of proper financing.

The most difficult challenges confronting small businesses simimlar to Warren Industries include attempting technology utilization although there may be a shortage of problem specific information, and where access, acquisition and integration of appropriate technologies are hampered by lack of readily available financing.

A presentation of the understanding by small businesses of the expected benefits as well as the risks and all aspects of the costs of automation must identify and distinguish how small manufacturers define automation. We must also distinguish between product and process technology.

Product technology is concerned with efforts to upgrade the level of technology offered in a product-it's a functional characteristic. There appears to be more interest in this type of technology by the financial markets looking to support development of the "better mousetrap".

Process technologies are able to impact how we design, plan, produce and manage our manufacturing activites. Process technologies have a more direct and long term impact on the real growth and survival of our manufacturing industrial base than product technologies which are often more susceptible to quick obsolecence.

The constant usage of the broad term "automation" may be one of the major barriers, or impedients, to smaller companies developing an awareness, interest and understanding of the benefits of technology.

Policy makers and others involved in facilitating and fostering increased utilization of "automation" -as it relates to efforts to improve American productivity, and therefore competitiveness, should use technology, not "automation", as a more appropriate term for discussion purposes.

We should not reference, or limit, our conversations and analysis to those glitzy, multi-controllable, photogenic, high-tech, flexible, computerized, robotically controlled machining cells contained in the totally automated factory of the future...some of the images very often projected with the term "automation".

Policy makers, and certainly financial institutions must understand that technology-as relevant or appropriate, accessible, and integrated into manufacturing will impact productivity, and will foster increased competitiveness.

I. Access to Funding/Financial Support for adoption of technologies is a key barrier for small businesses.

Coupled with the frustrations caused by identifying technology are the on-going frustrations experienced by small businesses concerning acquisition or funding of technology.

Traditional financial analysis tools and techniques are used by lending institutions-regardless of business size or industry specific adjustments that may be required.

In particular, traditional sources of financing for small businessees - commercial banking - has done more to harm small businesses with their fickle "lending appetites" than may now be evident.

Changes in borrowing formulas and frequent changing for preferences in financial instruments have led most traditional lenders to discourage commercial lending in favor of targeting efforts to those higher returns available through "consumer credit".

Who could really blame the banks for preferring to lend at 18% to consumers than to a small business? Small businesses may require a fair amount of administrative support and and these smaller credits often involve offering less lucrative services.

Even our financial instruments and financial markets have changed substantially, at a cost to our small businesses.

No longer is the value of a company, in the form of its stock, traded - but the value of an instrument as an investment itself.

As timely evidence, our financial markets recently reacted negatively to a variety of forces, none having direct bearing or relevancy to the performance of the companies whose stocks were being traded so furiously.

And now the banks want to participate directly in the securities markets...please...no. "Bankers" have not and cannot be trained to "weigh" risk against return, only to identify risk and dump it!

Certainly, we can not force banks to provide financial services to small businesses, but there should be a means for our industrial policies to encourage further support of our small businesses by the Banking community.

We must continue to bear in mind, Small Business is not small BIG BUSINESS.

Many small firms aspire to grow- to become big small business, but truly few hope to graduate to big business.

Commercial lenders too often erroneously subject small businesses to the same measurement criteria and standards as large businesses, even though the corporate goals and objectives, and most certainly the business organization, are radically different.

U.S. Small Business is a dynamic group of individuals - many of whom retain close ownership in a family business; who act as the entrepreneur - able to provide the valuable innovative spirit in management or a functional area; or as the managers who are attracted to the particular offerings of small business world (or who have tired of competition or other kinds of cultures prevelant in the world of "big business").

Further, small businesses may too often be defined by a "what" analysis: "what" size sales or revenues; "what" product lines; "what" number of employees ; and other criteria.

Our efforts to strengthen and enhance our economy might be better served using analysis from the perpective of "who" is small business; and for this, we need to become more aware and sensitive to their issues: What types of problems do they face in operating their businesses? how do they define their strengths and weaknesses? how do they perceive opportunities and threats?

Small businesses, while playing pivitol and critical roles and responsibilities in our U.S. economy and society, have survived interesting twists of recent major economic forces.

U.S. small businesses, like the big businesses, have survived the intricacies of double digit inflation and interest rates; particularly severe impact by foreign competitors; and most recently, major shifts in financial markets and financial instruments.

At the same time, many small businesses are privately and closely held. Profits are more likely to be measured in terms of providing a certain lifestyle for the owner, or in providing long term stable employment; rather than in traditional profit analysis or return to stockholder analysis.

Yet, members of our financial communities still attempt to use the same measurement tools for small businesses that are more effectively used in big businesses.

Given this perspective, technologies may not be as easily assimilated into smaller companies as they appear to be in larger companies given the particular operating conditions and organizational structures of small businesses.

We are talking about businesses where communication and information channels are more likely less formal, but none-the-less structured; decision making may vary from participative to autocratic, depending on the situation; a range of strategic and tactical planning activities are performed which take on special characterisitics-particularly in tactical areas- but most of all, planning must be flexible and responsive.

In small business, the owner may be the President and key manager, responsible for a broad range of daily activities-carefully dividing his time between functional areas, while at the same time-probably performing several functional roles himself.

The president may also act as CEO, CFO, Director of Banking Relations, Head janitor, etc. Members of our financial community do not know how to react to this "person" - nor to his organization, which they may view as a "disorganizzation" because they do not realize that in small business, almost everyone plays a variety of roles.

Additionally, many of our smaller businesses also participate in fascinating market niches. This serves to further confuse financial intermediaries, they are used to analyzing more widely available industry information and take a lack of industry information as a negative indicator.

Warren Industries, Incorporated for instance, participates in several markets, most falling under the broad SIC 38-instruments. Internally, we will use industrial information available under our SIC for planning and target purposes, but you can not yet find an SIC that covers our specific product lines. Without this type of information, bankers are reluctant to believe the forecasts and projections of the small businesses, because they cannot be backed-up in black and white.

I can not realistically suggest that we undertake an effort to educate our banking and other financial communities to support the efforts of small businesses, but I will strongly state that any effort to correct barriers to integrating technology by small manufacturers, must also address our severe problems in obtaining adequate funding.

Alternative financing sources, Venture Capital groups, for instance, in general prefer companies who have a new or novel product concept. I only know of one regional Venture group that has been successful in specifically targeting to "mature" companies. Unfortunately for most small businesses, they also usually require an "equity" position, something held very dear by the small business. We may willing to pay burdensome interest rates and to offer massive amounts of collateral for loans, but we are often reluctant to release on equity.

II. Identification and Understanding of Appropriate Technologies is another key barrier for small businesses.

The **identification** and **integration** of appropriate manufacturing technologies should be understood as the major influencer on the ability of U.S. manufacturers to sustain and increase productivity, and therefore enhance true competitiveness in domestic and global markets.

The concepts and examples of "automation" presented in most popular and targeted media appear beyond the reach and relevancy of many smaller manufacturers.

These manufacturers may not readily identify the connection between popular "automation" and their operations and specific circumstances or operating problems.

We should face the reality that many small companies would be hard pressed to readily find something to do with available technologies - without some type of assistance.

Manufacturers may even develop anxieties about automation; not unlike consumer frustrations caused by the illusions created by mass media advertising; therefore resentment and even reluctance regarding automation may develop which will further impact the assimilation of technology into products and processes of the small businesses.

Our small business have particular challenges in the identification and of the technologies which will improve and enhance their productivity and perfomance. We should develop programs and polices which encourage our small businesses to understand that technology can be used to address distinct business activities, from data processing-including coordinating elements of inventory control and production planning; to utilization of high performance materials and tools, in addition to machine tools.

Specifically, small businesses require individualized assistance in developing an awareness, identification and exploration of technology as it relates to their needs.

Often, assistance efforts must also generate interest, and responses to requests for additional information; and at the same time, serve to provide support and understanding by multiple-levels of the organization of technology and its benefits.

If this type of program approach were more readily, or conveniently available, the desire to acquire a technology could be fostered and the small business could then provide the relevant information to a supplier for adaptation of a technology to a specific set of criteria.

Too often, small businesses may be lead to believe that the mere action of attempting to integrate technology into their organization will produce the generic desired result - increased profit, but this could never be true, particularly not using off-the-shelf equipment, hardware or software.

Small businesses do not always have technologies adequately or fully presented to them to allow for understanding or integration.

Vendors and manufacturers involved in selling technologies to small businesses may hold many solutions, but at the same time they do not always have the insights to provide the solutions for the correctly identified "problem". Their goals are different, primarily they want to sell/install a technology.

Too often, the quick fix, in the form of a higher tech tool or technique, may be offered to resolve operating problems, when further analysis of the problem might provide a more appropriate, far reaching and longer term solutions.

WARREN INDUSTRIES' RELEVANT EXPERIENCES

It may be appropriate to relay some elements of Warren Industries, Incorporated in our efforts to identify and aquire appropriate technologies, to substantiate my statements.

Our company, for instance, while it strived to survive in our product markets, also continued to evolve as an organization. My initital reaction when I joined the company was that the company appeared to have been locked into manufacturing tools and methods of the late 1970's.

Operating criteria and conditions had changed dramatically and were continuing to change rapidly, but analysis and information flowed the way it was developed to flow over ten year's ago-even though significant changes had taken place in our markets and in our manufacturing process. Reporting systems were "automated", but did not allow for interactive analysis or control.

Upon further analysis and interaction, I realized that these tools and methods were still considered new, and radically different than the tools and methodologies previously used.

The company acknowledged that it needed help. We were looking, in fact, **pleading for help,** in almost any form. We identified and contacted numerous local, state and federal programs. Help - in the form of technical assistance was offered, and although we were not sure how it might our provide solutions to our situation, we readily accepted.

During 1985, while participating in a joint regional government and private industry council funded technology audit, it was identified that we **needed** to integrate some of the higher tech equipment currently available to metal workers, and that we should install an M-R-P (materials requirement planning) system.

Warren Industries would be the first to admit that this was not too difficult a conclusion to reach, given a quick tour of our plant and a brief discussion of our production methods and operating problems.

In fact, we had received the generic response all to often thrown to small businesses "automate" to fix your problems.

But little, if any, guidance was provided with the report, should automation save labor; materials costs; administrative time? Were we talking about new machines, or changes to our process? Was this why we were having problems? What were our competitors doing that was different? How should goals be identified and measured? where do we start? how do we start?

We were fortunate that the the group involved, quickly offered to provide us with the objective technical assistance required to review and analyze vendor information so that we would make an objective choice of machine tool and MRP system without being "committed to a specific vendor".

Initially, we assumed their recommendations were correct and we almost became bound by them. Certainly, their recommendations had been based upon their discussions with our production staff, and the group was providing engineers-they were the consultants, right?

We were provided with both engineering and financial analysis assistance, the consultants interacted with suppliers and in-house personnel to narrow our focus to those suppliers able to meet our "ideals". Let me note, in retrospect, for our own benefit, our "ideals" should have been explored and critiqued.

We were also given more appropriate financial analysis tools with which to measure the impact of our investment, and the group provided special assistance in our preparation of a funding proposal.

After many hours of analysis and decision making, we finally chose a horizontal milling center that we felt sure would solve all of our problems, and at the same time address our needs.

It was certainly a fine example of U.S. machine tool efforts: 24-tool capability, automatic indexing head, bar-stock feed, everything we could ever want in a machine tool.

The vendor worked very closely with us in establishing actual programs to test set-up and /cycle times to substantiate their claims of labor/materials savings.

At this same time, the company's working capital base had been completely consumed in a $1.2 million contract we were performing for the Army. We knew we would be unable to generate the working capital internallyto acquire the machining center, yet we felt the timing of the investment could be critical to gaining further profits on the contract and our other product lines.

We were ready to automate, to take that leap into tomorrow-but acquisition of the machine would require outside funding.

Unfortunately, we soon realized that the organization with the closest and most intimate relationship with the company - The U.S. Small Business Administration - had suffered numerous budget cuts. After several conversations they frankly suggested we look elsewhere for funding.

We requested and obtained information from every local, state, and federal program who might be interested in supporting this investment with us.

We finally identified a joint state/city program for which we were eligible which offered an extrememly attractive financing package for capital equipment acquisition. But it was coming to the end of a fiscal year, and budgets were being reviewed. We heard all the stories and fears about programs were being put on the "block", and it was suggested that we postpone formal request until the beginning of the next fiscal period.

We waited two months and contacted the program again, we were then told that the program goals and guidelines had been modified. With fifty six employees-we were no longer eligible for the program - we had become too big!

Hours of management, administrative and supervisory time appeared lost in preparation of numerous "applications".

The vendor, wishing to assist us, and to sell the machine, developed a unique and well tailored "vendor financed" package based upon our proposal. We were able to negotiate to reduce the down-payment required to as low as five percent and all tool-add-ons could be included under vendor financing which proved to be very attractive.

We then needed only the downpayment, some minor physical plant adjustments and to be responsible for the rigging costs.

We then prepared a loan request of the bank, total value requested was approximately $13,000.

Regardless of the fact that the machine tool we chose would have paid for itself in direct labor/same-as-cash savings in less than eight months, our bank rejected the proposal without review-stating that the bank had no interest in increasing it's loans to a company of our size above there current level. I feel I must note that the bank's loans had been placed in the early 1980's.

Since 1980 - our company had doubled in size, in revenues, and in number of employees because the company had been able to not only sustain market share in our traditional markets but we had also be successful in our efforts strategically attract larger volume production work, which clearly required an adjustment of working capital requirements.

Proceeds from an SBA guarnateed loan placed in 1980 had been used to upgrade machine capacity by adding several pieces of CNC equipment, and for use in the acquisition of electronic test and production equipment for integration of product technology.

Subsequest to the SBA assisted investment in technology, all working capital was being used to support manufacturing operations, not manufacturing strategies.

We couldn't get the financial assistance required to acquire and assimilate higher technologies, but by then it was also clear that there would be little support by commerical banks of small businesses in general.

When our loan request was rejected, we acknowledged - as a group that we could not reject our underlying objective and goal-to survive and continue to grow by increasing the use of available technologies in aspects of our business, but particularly in our manufacturing activities.

We certainly realized we had to be smarter, more knowledgeable and more creative in our efforts.

Regardless of the funding available, we had to up-date our manufacturing attitudes and processes in a meaningful manner for the long term development and survival of our company.

CLOSING COMMENTS

Small businesses have survived because they have been able to grasp and integrate those management techniques that have seemed relevant and appropriate.

In those companies participating in industries where foreign competition is particularly severe (there are few industries left that have not been impacted - directly or indirectly - by foreign competition) automation is often seen as a strategic element of competition.

In particlar, many businesses have been able to survive and grow during unique blends of: economic, social and financial conditions using "technology" based strategies. As we continue through the 80's and certainly into the 1990's, this should become an increasingly more critical strategic issue in our industrial policies and programs.

Some small businesses have successfully utilized technology in the development of innovative product lines or unique market opportunities which have provided for market survival and may have also served to attract top talents in design and process technologies, almost ensuring a better chance of success.

For other companies, the level of technology of the product may dictate very price competitive strategies; such as becoming the lowest cost producer of such "commodity" products as screws, fasteners, or gears; or product strategies that allow developments of small, often secure, market niches or which may be condusive to hollowing out a more secure market strategy such as specialty steel processing.

Often small businesses may feel pressure to increase automatation where there is a strong "pull" for higher value (lower price; shorter order processing) by customers-particularly in industrial product markets.

As our small firms endeavor to increase their competitiveness, programs must be designed and managed to offer specialized and personalized assistance in identifying and assessing appropriate technologies. Presently, there are a number of these programs available, unfortunately, their program goals may not match well with the goals of their targeted clients-the small businesses.

We must also ensure that the financial requirements for our small businesses to acquire and integrate available technologies are readily available. This will most certainly be the most difficult, but also most critical, task any program for integrating technologies will address.

Senator LEVIN. What was the technical assistance center you made reference to twice?

Ms. CONRAN. That was a city program.

Senator LEVIN. Would each of you comment on the practicalities of leasing automated equipment and advanced technology?

Mr. Buerk, why do you not start?

Mr. BUERK. Well, any time you lease, if it is an automobile, or rent a house or lease a piece of automated equipment, there is normally an exchange of dollars somewhere along the line, and it is going to cost you money, and the reason it is going to cost you money is nobody works for nothing, and every time that title transfers, if I am using the correct terminology here, somebody is going to take a penny or two off the dollar value.

Senator LEVIN. So there is not a lot of that going on in this area?

Mr. BUERK. No. The other problem is it is a high risk situation because we were talking out in the hall and pointing to a computer and saying, you see that computer over there which is right outside the door here? I said, that computer is obsolete. I can go down to the corner computer store and find one.

And I said, now, the danger of that is that that one is obsolete because there is some character somewhere in a garage or a laboratory or a skunk works at some computer corporation that has just made the last one obsolete.

The same thing with automation. In 1963 we bought our first so-called NC machine tool. It was a terrific thing. People would come from miles around. It was the first time anybody had seen a machine center in a small shop. And we were sort of the oddball within our industry. But it was not more than 2 years later that the company that made that, which was then called Cincinnati Lathe and Tool, which is now part of Cincinnati Milacron, obsoleted it. It was 2 years.

Now what happens is whatever we buy, and we just acquired a high-tech grinder, and I was joking with our plant manager, and I said, Harry, you see that machine over there? It is obsolete right now, and it is not even in its foundation.

So what happens is when you lease something, the leasor is at a high risk because that may be obsolete tomorrow.

Senator LEVIN. OK, thank you.

Mr. Stokes, would you go next?

Mr. STOKES. Well, like Mr. Buerk, I have not observed a lot of leasing in my experiences, but I can see it. If a small business has an immediate opportunity, kind of like what Ms. Conran spoke about earlier, if a small business has a good package and sees some opportunities to move into something, certainly leasing from the standpoint of the financial aspects, as not having to come up with all of the initial capital, is a way of being able to implement a technology and pay for it out of the cashflow.

Senator LEVIN. Is there a lot going on right now that you know of?

Mr. STOKES. I am not aware of a lot of it.

Senator LEVIN. Ms. Conran?

Ms. CONRAN. We currently lease two pieces of equipment. We are very satisfied with the arrangements.

Senator **Levin**. Did you lease this last piece of equipment you described?

Ms. **Conran**. No, I did not get it.

Senator **Levin**. Could you have?

Ms. **Conran**. We explored that option. Actually the biggest problem in acquiring the new technology was having to rearrange my shop and to bring in enough electrical power to run it. That required infrastructure and some work there.

Senator **Levin**. Because of the hour, I am going to ask each of you just one last question, and some of you have touched on this before, but I would like you to boil down your two top priorities, if you have them, for the Federal Government in terms of encouraging the utilization by small business of advanced technology or removing impediments that exist now.

It could be the tax area, antitrust area, regulation area, anything you want.

Now, you have said we have got to do something about the banking.

Ms. **Conran**. Well, there is an alternative.

Senator **Levin**. That is too general. I want you to be as specific as you can. Take a minute or two each, given the hour, just tell me the two top priorities, and we will start with you, Ms. Conran.

Ms. **Conran**. In talking about the two top priorities——

Senator **Levin**. This is for the Federal Government.

Ms. **Conran**. They should be addressing the problems related to identifying the appropriate technology and then the acquisition. My concern is that there is not a means for the financial backing of the acquisition.

There are several Federal programs, and I am a big fan of the SBA. Why is the SBA not being used for this? They are the ones that are closest, who have the most sophisticated, if you will, administration. The fractionalized state programs and city programs compete with each other.

Senator **Levin**. Just briefly, did you try SBA?

Ms. **Conran**. Yes, we did.

Senator **Levin**. And they——

Ms. **Conran**. At that point in time they were up to their limit on this guarantee, but there are communication channels existing in programs right now that are not being utilized. We do not need to develop new programs. We might want to even get rid of a few of them.

Senator **Levin**. Mr. Stokes.

Mr. **Stokes**. I would like to take off a little bit on what Ms. Conran said. In the area of selection, as to what technologies apply, and I think that would be the first priority, and as I mentioned in my statement, I am supportive of this section of the Technology Competitiveness Act, for the establishment of regional type of technology transfer centers.

I think this would be a good area for a lot of technology to be demonstrated, and a lot of training could go on there where small businesspeople could come there, see what is available to them, and get involved with it in that respect.

The second area which I also mentioned in my statement was in the area of maybe making good use or restructuring JTPA—I know the JTPA is a fairly extensive thing, but I feel like if a small business manufacturer is going to make a substantial investment in a specific area of technology that is recognized as a move forward in the overall competitiveness of the Nation or something, that possibly since we do have this training program in place for retraining, there could be some opportunity there for the small business manufacturer to benefit in a similar way as the program now has, to benefit in the training and upgrading of existing employees to higher paying, more technically based jobs.

Senator LEVIN. Thank you.

Mr. Buerk.

Mr. BUERK. Again I am going to go back to my theme of generic help. Do not help me, help us all. Tax reform reform.

Senator LEVIN. Did your association, by the way, take a position on tax reform?

Mr. BUERK. I have no idea. I am not here to represent my association.

Senator LEVIN. I say, did you take a position last year?

Mr. BUERK. I am not aware. I think they did. Yes, I think they did, and as I recall, they were shouted down or they were not heard or something. I am not part of that.

But I think they were not successful. The reform went through.

Senator LEVIN. I think we want to get a clarification here.

Mr. HAHN. Yes, I am Bruce Hahn with the National Tooling and Machining Association, and we were opposed to the reform.

Senator LEVIN. Were you publicly opposed to it?

Mr. HAHN. Very publicly opposed, but we were outshouted, and primarily to the ITC and depreciation.

Senator LEVIN. Real good. Thank you.

Mr. BUERK. So anyway, I think what we have to do is we have to—if you could have the Federal Government take their dollars later rather than earlier, that would give us capital so we can, if you want, everybody or anybody can make their own acquisitions.

And the other thing is education. I think the Federal Government has sources of information that could be broadcast. I think that they can be doing relationships with, if you want, your land grant colleges and universities, whatever they have been doing over the last 100 years. You have got a great track record in agriculture. Do it in manufacturing.

Senator LEVIN. That is a pungent point you make about short term/long term. Indeed, I think all of our witnesses probably in one way or another have touched on this issue. It is partly cultural, in the governmental sense, partly political. Running for office, people tend to look for a short-term payoff, just the way people in business may look for their—they are told by their stockholders or whatever that we need a short-term return. But for whatever reason, cultural, political or otherwise, we all tend to look for short-term payoffs.

I tend to agree with that. I do think that we are not particularly strategic, either. Small business is not unique in that. I would agree with Ms. Conran on that. She does not feel that that criticism perhaps applies at all. I think it applies to all of us, that small business is not unique. We tend to look for the short-term payoff in this country. It is hurting us drastically.

Your comments about how we should be willing to accept a longer term payoff is very, very well taken, I think. If you look at the tax, or the deficit situation that we are in right now, we are struggling desperately to find a few billion dollars in the short term in order to give a sign of confidence to people. That is a very short-term thing we are looking at. The idea of providing now a tax incentive now with a short-term loss to the Treasury but a long-term payoff runs counter to the tremendous momentum we have to do something now about the deficit.

And that is rather typical, maybe not as dramatic as it is at the moment, but it is rather typical around here that we need to do something short-term rather than long-term. So I think your point is very well taken. And it is really partly a cultural problem, I am afraid, with all of us.

Let me wind up with you by expressing our gratitude to the three of you for coming today, for taking the time for your testimony. It will be made a part of the record, your written testimony, and this is a subject that we will be having future hearings on. It is a long-term solution. It is not a simple solution. We have asked you to boil down on a number of occasions, some of you have repeated your points. That is even helpful. It helps get through the message that you have presented very, very effectively today, and we are grateful for it.

We stand adjourned.

[Whereupon, at 12:35 p.m., the Subcommittee adjourned.]

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81-418 (200)